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MACHINE tool designers have constantly before them the problem of getting greatest convenience of manipulation and working range combined with an unflinching control of the work and tools.

The firmness of control comes first and should be as nearly ideal as it is possible to obtain; after that, any extension of working range is not objectionable—on the contrary, it is highly desirable, to meet the ever-changing conditions of the work on which machine tools are used.

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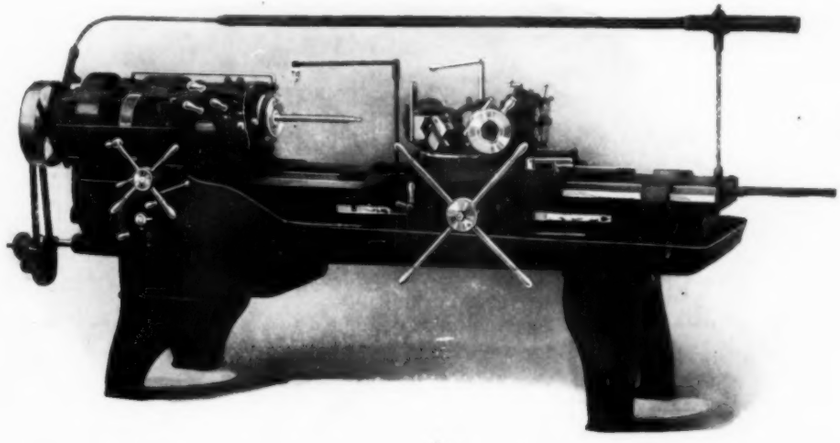

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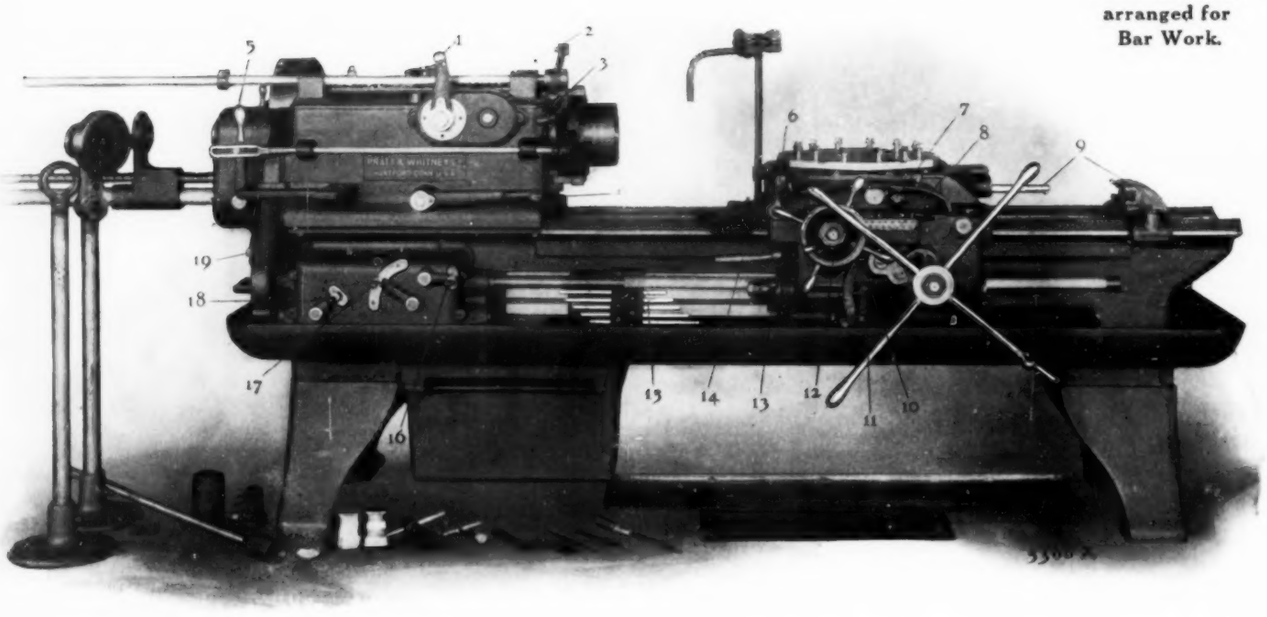

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3 Chuck Lever
4 Speed Back Gear Lever
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6 Turntable Binder
7 Transverse Stop Change Knob
8 Transverse Stops
9 Index Abutments
10 Feed Disengaging Lever
11 Feed Engaging Lever
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19 Oil Pump

A Manufacturing Tool—

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Building a Steam Fire Engine

By F. A. Stanley

How the pumping unit of a high grade fire engine is constructed so that all of its parts may be assembled and then mounted as a whole upon the frame of the engine without affecting the alinement of the machinery.

The methods, tools and gages that insure accurate work and facilitate each and every operation. Some interesting features of construction shown in detail, with notes on a variety of machining and testing processes.

The "steamer," built by the Ahrens-Fox Fire Engine Company, Cincinnati, Ohio, is of novel and interesting construction in that its pumping unit is self-contained, the entire mechanism consisting of steam cylinders, pump end, pistons and connecting rods, as well as the boiler-feed pumps, being carried by columns and bed plate on which the pump is completely assembled before it is attached to the steel frame of the vehicle. With the pumping unit erected in this way there is no possibility of its being thrown out of alinement when attached to the fire engine frame or during service.

The appearance of the complete fire engine is well shown by Fig. 1, where the "suction" is shown removed from the right-hand side in order that the pump may be more clearly seen. Three views of the pumping unit are presented in Figs. 3, 4 and 5, which illustrate the method of attaching the steam and pump cylinders to straight-line columns passing through the heavy central bed plate. The view in Fig. 3 also shows the manner in which the two small boiler-feed pumps are housed in chambers bored through the side of the bed-plate casting.

The pumping unit is double acting and the steam cylinders are formed in one casting, as are the two pump cylinders. The machining of the various parts involves the use of a large number of special tools and gages, and the manufacturing methods throughout are such as to assure the production of accurate work and enable the different parts to be readily duplicated.

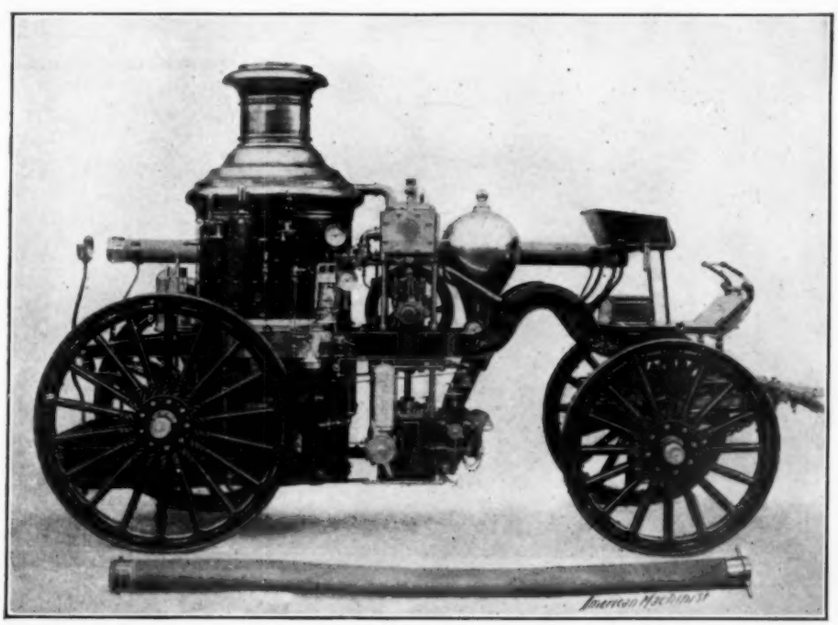


FIG. 1. AHRENS-FOX FIRE ENGINE

MACHINING BEDPLATES

The casting forming the bedplate of the pump is seen clearly in the views of the assembled machine, and is shown by itself in Fig. 2, at the right of the radial-drill table. This casting is planned carefully to insure its being square on both ends and faces, with opposite surfaces perfectly parallel with each other. The fixture which is used for boring the six column holes *A A* and the two holes at *B* for receiving the feed-pump cylinders, is so designed that unless the bedplate is correctly planed it cannot enter the fixture.

This boring fixture is shown on the radial-drill table in Fig. 2, and the method of guiding and driving the boring bars is brought out clearly. The bar is guided at top and bottom, and the drive from the spindle is by a form of floating connection, so that the boring bar is free to run properly in its bearings in the fixture. The bushings at the top are changed from hole to hole and are provided with a short locking pin, which enters a spiral groove in the fixture and so holds the bushing down in its seat. Two bars are used for this casting, the smaller one being shown at the back of the fixture.

GAGES FOR COLUMNS

Of the six columns which are used to connect the steam and pump ends, there are four of equal length for the corners, while the two central ones are of slightly different form at the lower end to facilitate assembling. The over-all-lengths on the outside shoulders, which determine the distance between the steam and pump cylinders are, of course, exactly alike. In Fig. 6 four different columns are illustrated with the gages to which they are manufactured. The diameters are sized to micrometers and suitable gages not shown; the lengths from shoulder to shoulder are brought exact by gages of the type illustrated.

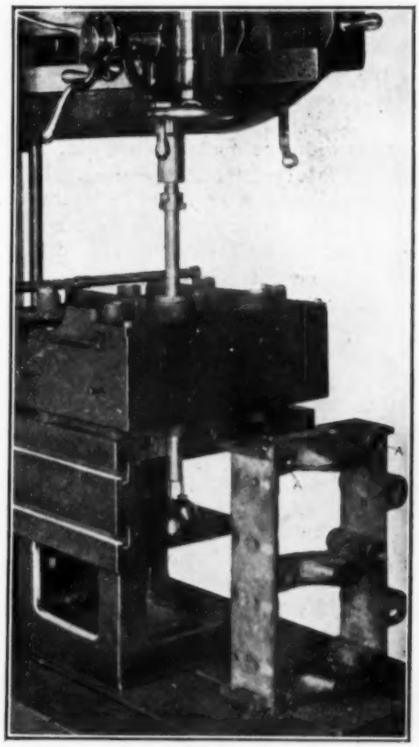
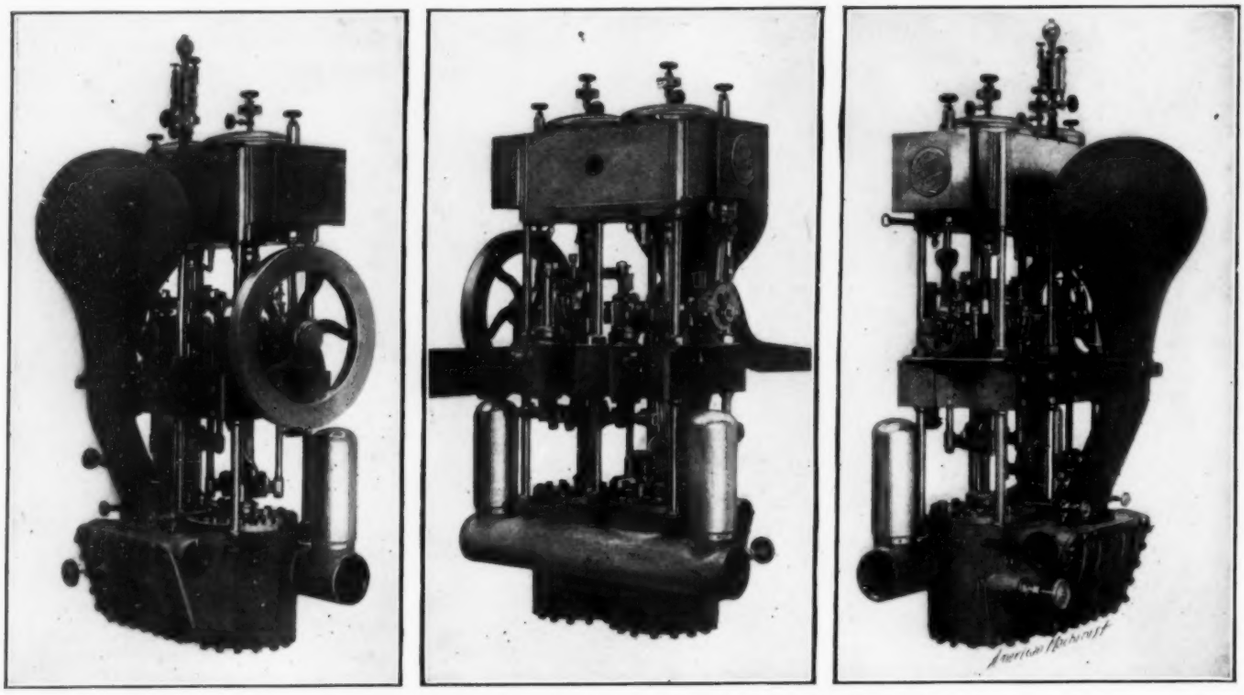


FIG. 2. BORING COLUMN HOLES IN BED PLATE UNDER THE RADIAL DRILL



FIGS. 3, 4 AND 5. THE PUMPING UNIT OF THE AHRENS-FOX FIRE ENGINE

A PUMP BORING OPERATION

The pumps and steam cylinders are bored on a special fixture carried by the lathe, in Fig. 7, which shows the pump casting with a boring bar in position. This casting is of composition bronze. It is supported against an angle plate and at either side are supports for the bar carrying the tools. The bar itself is driven by a form of universal joint which connects it with the spindle of the lathe. The special table upon which the work and the boring-bar supports are mounted has at each end T-slotted guides, upon which the boring-bar supports are slid in changing from one cylinder to the other. Two stops are affixed to these guides and the correct distance between centers is obtained by setting the boring-bar supports against distance gages which are placed between the ends of the supports and the fixed stops upon the table.

Double-end cutters are used in the bar and these are followed by a reamer, which is shown in operation in Fig. 7. The steam cylinders are machined in similar fashion.

JIGGING THE PUMP

The pump casting is shown more clearly in Fig. 8, where it is represented with the valve seats and cover studs in place. A number of these seats and other valve parts are seen in front of the casting, and to the left will be noticed one of the shells which is fitted in the opening bored in the casting and forms the pump cylinder. Fig. 9 illustrates the jig for drilling the stud holes and the holes for the columns which connect the pump and steam cylinders. This jig plate is located on the pump casting by two cast-iron spools, or spiders, whose flanges fit accurately in the pump cylinders while their upper ends are a nice fit in two locating holes bored through the jig. The type of bushing used with this jig is plainly shown.

MAKING CRANK SHAFTS

Some crank-shaft tools are represented

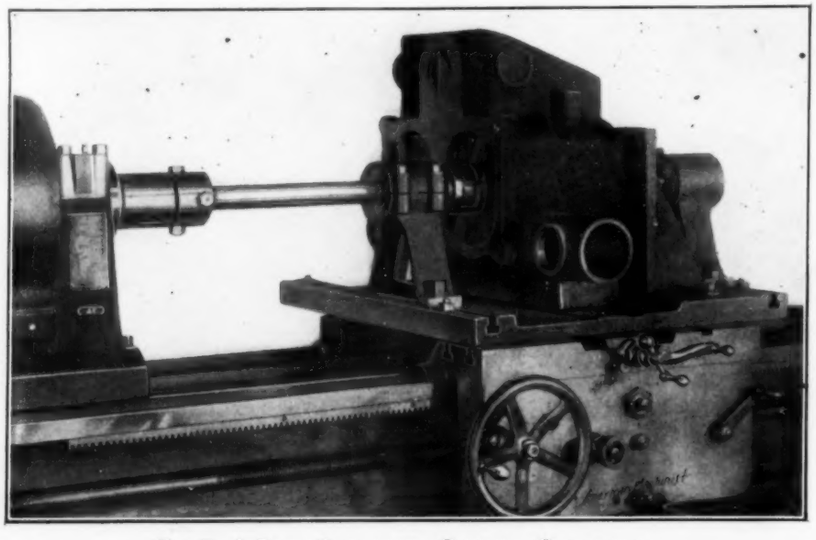


FIG. 7. A PUMP BORING AND REAMING OPERATION

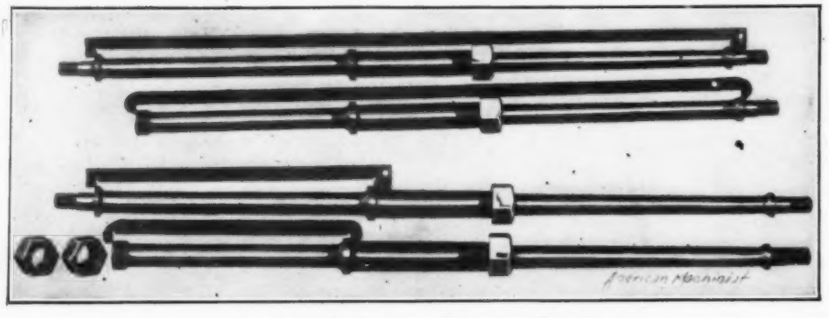


FIG. 6. A SET OF COLUMN GAGES

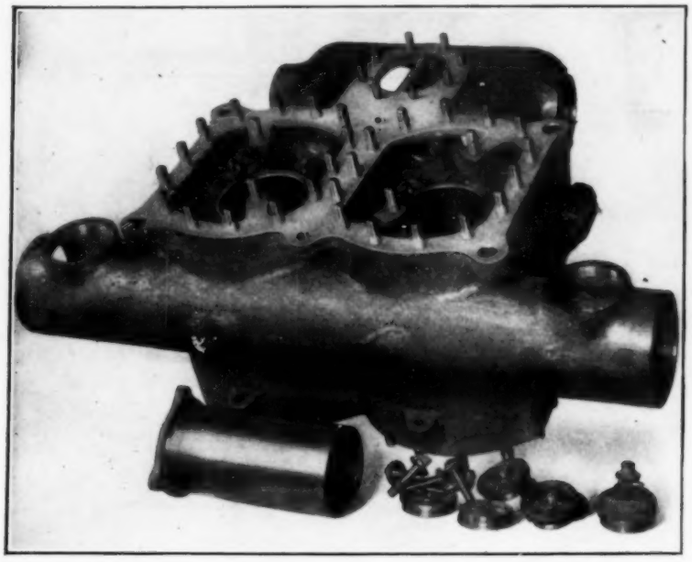


FIG. 8. PUMP WITH VALVE SEATS AND STUDS IN PLACE

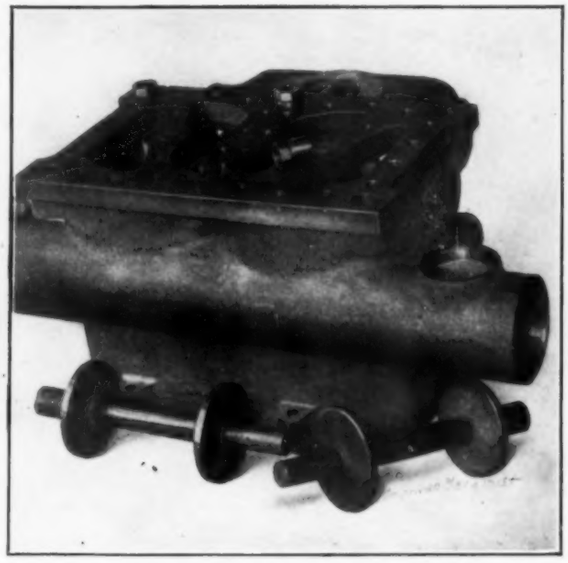


FIG. 9. PUMP WITH DRILL JIG IN POSITION

in Fig. 10. The rough shaft is shown in the background and in front will be noticed two finished shafts with the centers upon which they are turned, and the gages to which they are brought for correct length of bearings, distance between shoulders, etc.

The crank shafts are first roughed all over and the outer journals turned on centers to receive the crank centers *C C*, which are provided with 60-degree centers formed in steel plugs hardened and ground and pressed into place in the castings. These inserted centers are located at the correct distance for the wrist pins and the curved outer ends of the webs. One pin is first finished to the gage *D* for length and to micrometers for diameter. Then with the offset gage *E*, which is fixed to a head that slips over the finished pin, the lathe tool is set for the facing down of the second pin, which is then turned to length by gage *D*. This locates the pin shoulders at the required distance apart, and the snap gage *F*, which has a body that drops over the finished pin determines the distance between the inside shoulders on the journals. Another gage is shown at *G* for the length of the middle bearing, and still another at *H* for the end bearings.

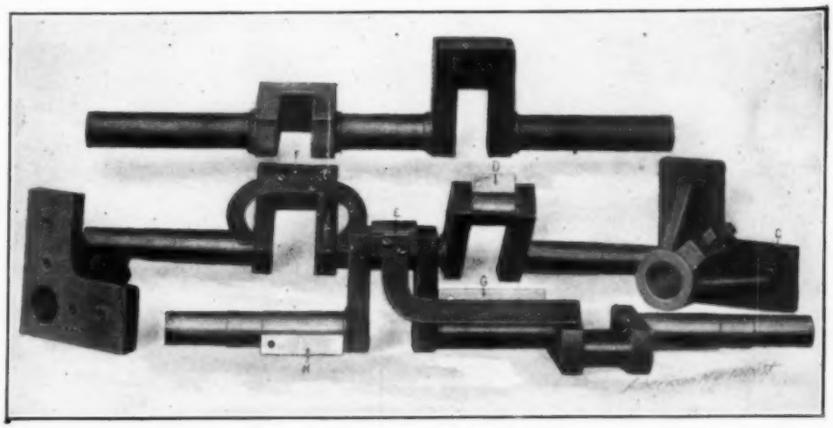


FIG. 10. CRANK SHAFTS, CENTERS AND GAGES

FINISHING JOURNAL BOXES

The bronze boxes for the crank shaft are handled with the tools illustrated in Fig. 11. The boxes and their caps are planed top and bottom and to form the joint, and the drill jig *I* is then applied to both boxes and caps, this jig being reversible, the tongue at one side fitting the cap seat planed in the box and the groove in the other face of the jig fitted the lips of the cap. The jig is located from the rough ends of the work. The box is drilled and reamed for the shoulder studs; the cap is drilled with 1/32 inch

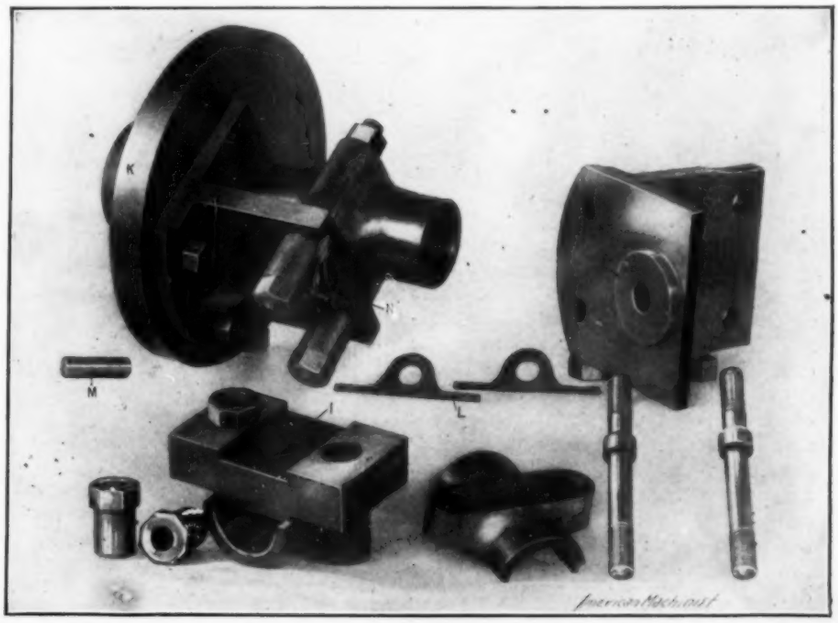


FIG. 11. TOOLS FOR CRANK-SHAFT BOXES

clearance for the studs. The three bushings used by this jig will be noticed in the engraving.

The angle plate upon which the box and cap are mounted for boring, etc., is provided with a locating boss *J*, which fits a recess in the lathe faceplate *K*. The liners used between cap and box are shown at *L*. An end gage *M* is placed against the boss at *N* for setting the facing tool at the right point for finishing the ends of the work.

An Alining Fixture

The crank-shaft boxes are alined on the bedplate of the pumping unit by the method illustrated in Fig. 12. Here the bedplate *O* is shown fitted with the six columns, to the upper and lower ends of which are fixed dummy plates *P* and

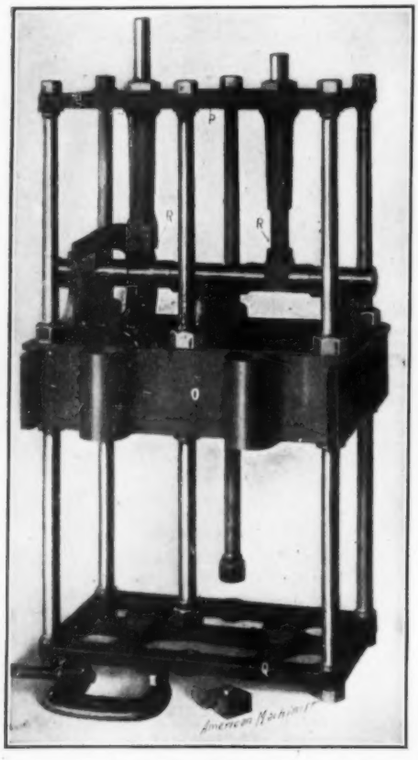


Fig. 12. Fixture for Locating Boxes in Bedplate

Q, which take the place of the steam cylinder and pump castings and allow the work to be carried on under the same conditions as if both castings were actually connected with the columns. The upper plate *P* is fitted with two long sleeves carrying two locating rods *R*, which are thus positioned at the same center distance as the piston rods. They are formed at the lower ends to fit over a master shaft whose journals correspond to those on the crank shaft. The three boxes are placed on the bedplate to receive this master shaft and the locating devices *R* are slid down into place over the sections of the shaft corresponding to the pin bearings on the crank shaft. This positions the boxes correctly on the bedplate and they are then clamped firmly in position so that they can be drilled in place for the reception of the regular crank shaft, after removing the locating apparatus.

Piston-rod Yokes

The piston rod for the pump is of tobin bronze; for the steam cylinders, of steel. The rods are provided at their outer ends with steel yokes, as seen in Fig. 13, which have four holes at the corners for the

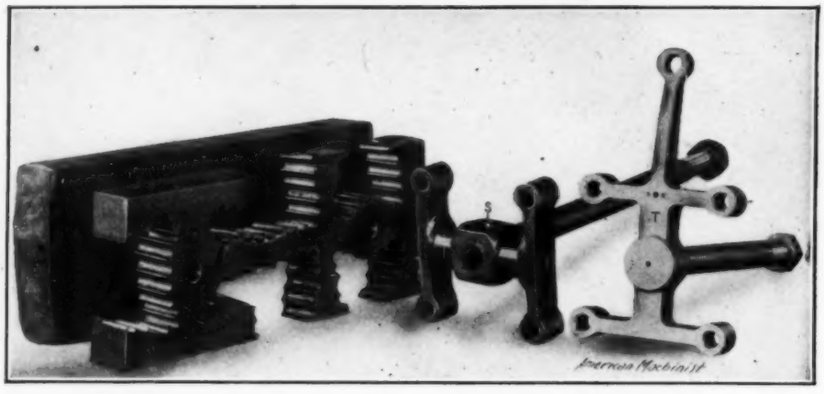


Fig. 13. Piston-rod Yokes in the Rough and Finished

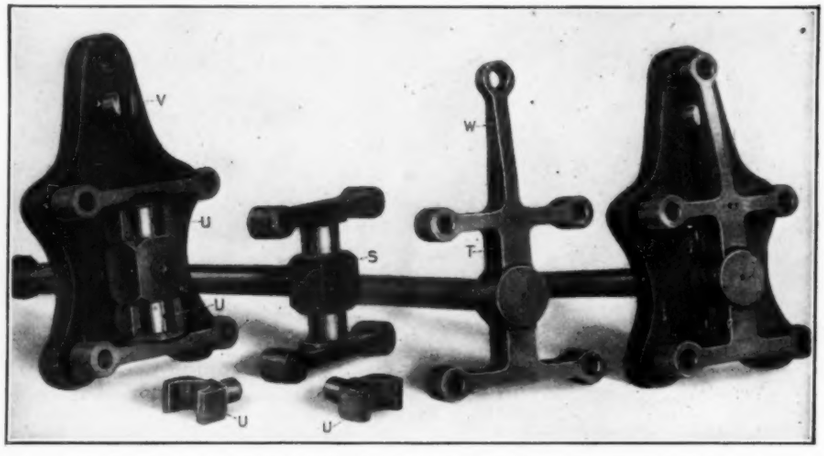


Fig. 14. A Pair of Yoke Jigs

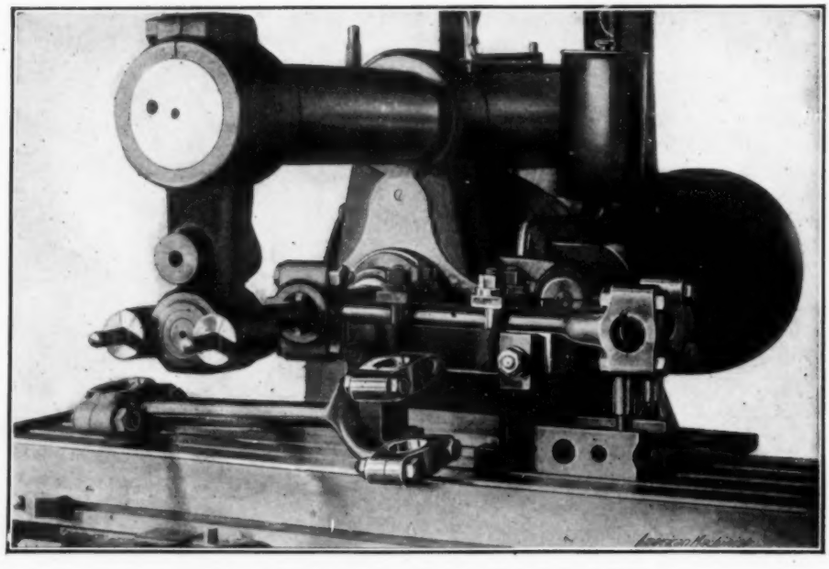


Fig. 15. Boring Connecting Rods on the Miller

four connecting posts and rods. The yoke on the pump piston rods at *S* is formed with a pair of wrist pins for the connecting rod and the yoke *T* on the steam piston rod has an extension for operating the feed pump. Both yokes are cut out of a solid-steel slab by drilling a series of holes and they are then finished to size and correct outline, as illustrated.

The holes are drilled with jigs of the type seen in Fig. 14. Each of these jigs answers for both pump and steam yokes. The jig to the left is shown slipped over a pump piston rod with the yoke located for the drilling by means of two swiveling brackets *U*, into which the wrist pins fit nicely, bringing the centers of the yoke bosses in line with the drill bushings. For drilling the steam piston-rod yoke *T*, the two blocks *U* are removed and the slotted guide *V* then receives the extended arm *W* and sets the yoke correctly for the drilling operation. The jig to the right is shown as used for steam piston-rod yoke.

Connecting-rod Operations

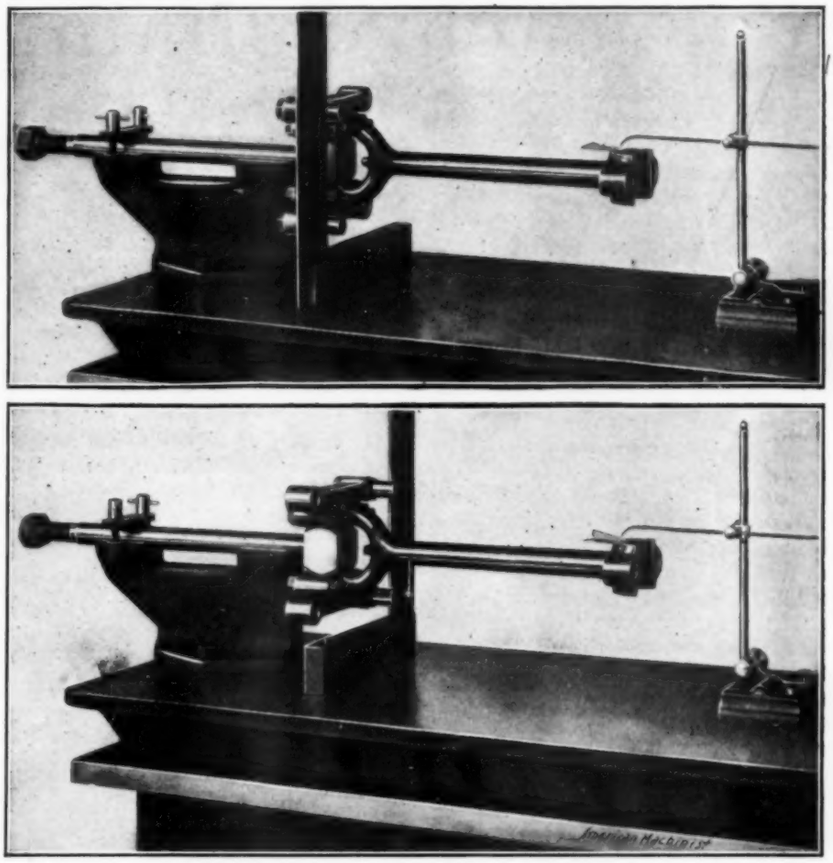
The bronze connecting rods are bored on the milling machine, while held in the fixture illustrated in Fig. 15, which requires little explanation. In this fixture the work is rigidly supported and a double-end cutter is used in a bar with the outer end supported by the overhanging arm of the miller.

While these connecting rods are being fitted to the yokes they are tested, as in Figs. 16 and 17. The piston rod is placed in V-surfaces in a fixture on the surface plate and two test plugs are slipped into the yoke by means of which the work is set with the blade of the large square on the surface plate. The scriber of the surface gage is adjusted in contact with a piece of tissue paper on the upper face of the bearing at the crank end of the connecting rod, as in Fig. 16, and the work is then turned half way over, reset square by turning the square around, as in Fig. 17, and the surface gage again applied as illustrated. The ends of the bearing at the outer end of the connecting rod have been finished central and square with the rod itself, and in the test shown, if it is found that the rod bearing is "off" to one side or the other, the bearings on the yoke are rescraped to "throw" it in the required direction, so that it shall line up with the crank-shaft pins when assembled.

The two test plugs used in connection with the square are used again inside of the bed plate in erecting the pump, to facilitate other alining operations.

Copper Air Vessels

The air vessels for this pump are of the shape illustrated in Fig. 18, which shows how one of these receptacles is mounted in the lathe for finishing. It is made of copper about 3/32 inch thick and is provided with a flange at one end, which is grasped in the three-jaw chuck, while the outer end is supported by a special center. The copper shell, while quite light in weight, is of such dimensions as to require a good-sized lathe to swing it. While held in the manner represented it is filed and polished to a smooth, bright surface.



Figs. 16 and 17. Testing Connecting Rods

Waste in Shop Supplies

Much of the waste in supplies that is too evident in the cost records of many shops is due to ignorance rather than intentional wastefulness.

There is a happy mean between wastefulness and niggardliness in the matter of supplies, which is more economical than either extreme. Both have a bad effect on the men. The former makes him careless and wasteful, while the latter arouses a very natural resentment and has a result very similar to the first.

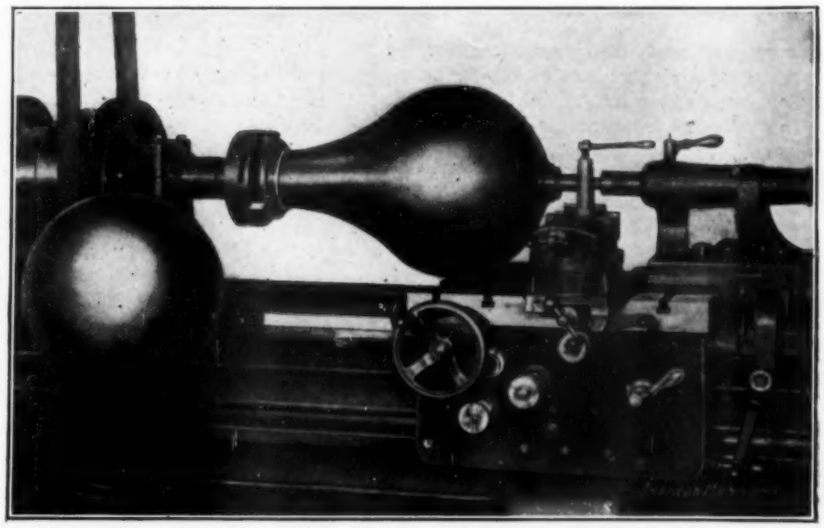


Fig. 18. Copper Air Vessel Mounted in Lathe for Finishing

A French Splining Machine

By Edmond Leymarie

A type of machine used in many automobile shops, having an oscillating movement to the spindle, the effect of which is to produce slots and keyways with satisfactory ends by overcoming the spring of the cutter arbor or shank.

The machines formerly in use for cutting slots and keyways in shafts or other pieces comprise a fixed spindle, or a movable spindle which travels parallel to its axis. As a result, when we wish to cut a slot of small size, the tool, being too flexible, has a tendency to bend when it reaches each end of the cut.

This effect is shown in Fig. 1.

Referring to this figure, in diagram *a* is the piece of work, *b* the slot that is being cut, *c* the arbor carrying the tool, and *d* the tool itself. This bending results in frequent breaking of the tools, and, especially, in making conical slots, as clearly indicated.

Messieurs Lubin & Weiffenbach, machinery builders at Clichy, near Paris, France, designers of many special high-duty machines, have brought out a splining machine that is very interesting for this class of work, and which has been adopted by the majority of the large French automobile builders and by numerous machine shops.

These gentlemen have succeeded in overcoming the disadvantages explained,

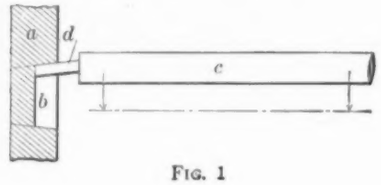


FIG. 1

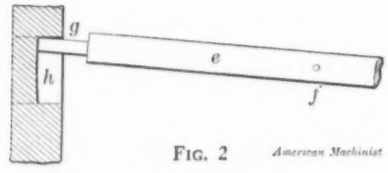


FIG. 2 *American Machinist*

DIAGRAMS OF SPINDLES OF SPLINING MACHINES

by adopting a tool-holding spindle *e*, Fig. 2, which has a movement of oscillation around the fixed point *f*.

This movement results in presenting the tool *g* at each end of its cut at a certain cutting angle, which renders impossible the bending and its injurious effect, the back part of the tool being always free.

By this means is obtained a keyway of equal dimensions end and beginning.

This machine, patented in France and abroad, is constructed in three different types, according to the sizes of the slots that it can cut. Type No. 0 is for slots 1 to 7 millimeters (0.04 to 0.28 inch) wide and 20 millimeters (0.8 inch) long. Type No. 0 bis. is for slots up to 15 millimeters (0.6 inch) wide and 90 millimeters (3.6 inches) long. Type No. 1 is for slots up to 18 millimeters (0.72 inch) wide and 120 millimeters (4.8 inches) long.

The principle of these machines having been definitely stated, we shall pass to the description of Type No. 0, as being the simplest and shall refer to two views, a sectional elevation and a plan of the top, Figs. 3 and 4, and the half-tone, Fig. 5.

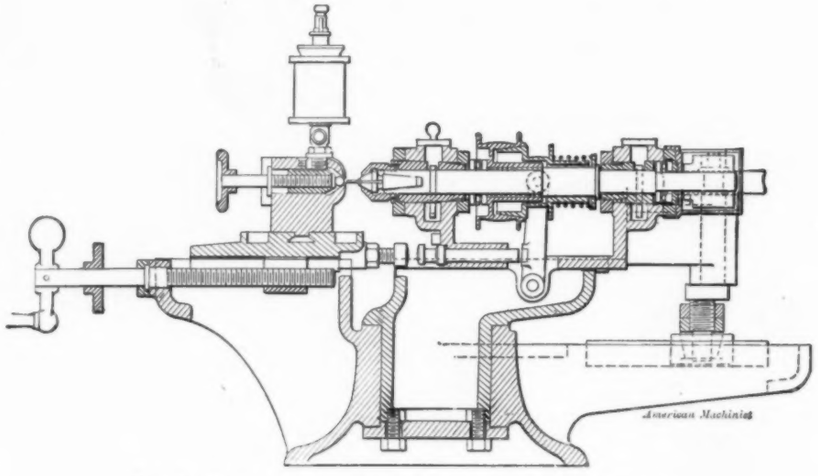


FIG. 3. ELEVATION OF FRENCH SPLINE-MILLING MACHINE

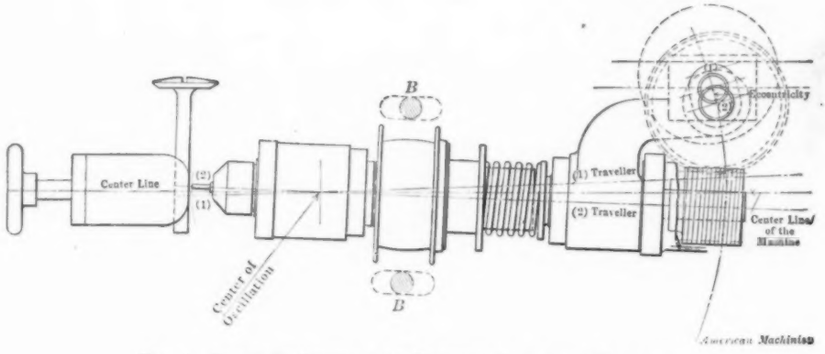


FIG. 4. PLAN OF SPINDLE OF FRENCH SPLINING MACHINE

The oscillating cutter spindle is driven by a friction pulley, which avoids any countershaft. The cut being finished a stop automatically acts upon the friction, and stops the machine. The oscillation of the cutter spindle is automatically controlled through a worm, a wheel, and an eccentric shaft having a slide supported by a fixed guide on the back of the machine. The length of the oscillation is obtained by an adjustment on the swiveling carriage.

The work carriage is driven by hand.

This machine is used to cut small slots, for example, those in the valves of automobile motors.

MACHINE TYPE NO. 0 BIS.

This is a heavier model than machine No. 0. In automobile work, it is suitable for cutting the slots in speed-changing levers, and similar purposes.

Used by hand, without the automatic feeding mechanism, it will cut keyways. Its table is arranged to use a set of centers or any other appropriate fixture.

The frame, serving as an oil reservoir, supports the oscillating table carrying the cutter.

A lower cone pulley forming the general drive transmits at will, by belt, speeds to the cutter spindle.

The oscillating movement of the cutter has three speeds and the amplitude may

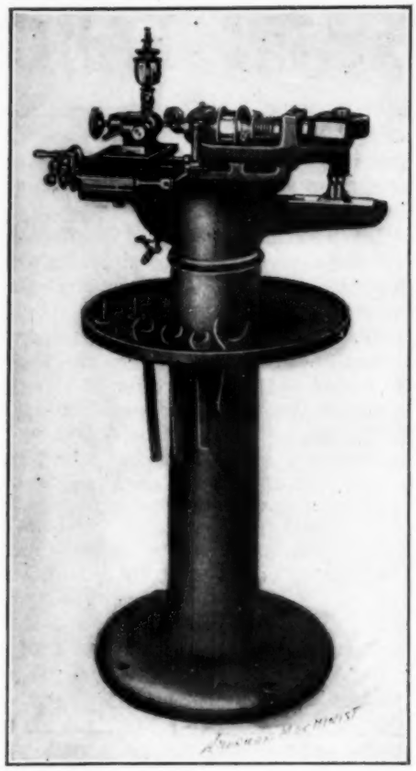


FIG. 5. SMALL SIZE FRENCH SPLINING MACHINE

be varied. The work table has longitudinal, cross and vertical movements.

The cross feed of the table is automatic and variable. An automatic stop checks this feed at the point desired. The work is continuously lubricated by means of a pump.

As an example of its efficiency, a slot 35 millimeters (1.40 inches) long, 35 millimeters (1.40 inches) deep and 9 millimeters (0.36 inch) wide, has been made in semihard steel in 10 minutes.

MACHINE TYPE NO. 1

This machine, which is more powerful than those of type No. 0 and 0 bis imparts to the cutter spindle, besides the oscillating motion, as in the preceding machine, a rectilinear movement which enables it to cut not only slots but keyways automatically.

It will take, like machine No. 0 bis, a vertical vise, a fixture with centers or any other appropriate fixture. It has a heavy frame, see Fig. 6, on the top of which are three carriages.

1. The lower cross carriage is used for the feed of the cutter.
2. The intermediate longitudinal carriage is used for the longitudinal movement of the cutter, for keyways.
3. The upper circular carriage enables the cutter-spindle head to perform its oscillating movement.

The length of grooves and slots is regulated by a crank whose radius of eccentricity may be increased or lessened.

A three-step cone with change gears gives six different rates of longitudinal feed to the cutter. An adjustable pawl gives the suitable feed of depth to the lower cross carriage, which is controlled by an automatic stop. A three-step cone gives three different speeds to the cutter spindle. A pump forcing lubricant from a reservoir arranged in the table knee, constantly lubricates the work.

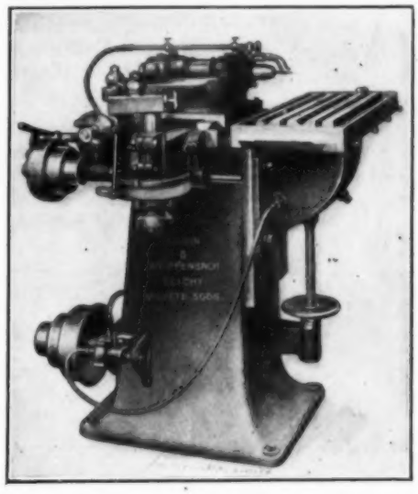


FIG. 6. LARGE SIZE FRENCH SPLINING MACHINE

The work table has longitudinal and cross movements.

As an example of its efficiency, a slot 50 millimeters (2 inches) long, 50 millimeters (2 inches) deep and 15 millimeters (0.6 inch) wide was cut in semihard steel in 10 minutes.

Depending on the Other Fellow's Tests

BY JOHN R. GODFREY

While the spirit of investigation is responsible for much of our progress along mechanical lines, it is also apt to lead to disconcerting and misleading conclusions unless we are particularly careful. Tests of machines and other devices, like testimonials for hair restorers and other patent medicines, are looked upon with suspicion in many quarters and it is a very common saying that no test is of any value unless we know all the conditions, and, more than that, know the man or men who made them.

It is undoubtedly true that too many tests have been made for the distinct purpose of proving the advantages of certain patent devices, and it has also happened that the efficiency of the device has borne a direct proportion to the size of the expert's fee. I firmly believe, however, that these cases are the exception, rather than the rule, and I am not nearly so much afraid of dishonesty as of self-delusion.

When a man is intensely interested in a certain device, it is extremely difficult for him to make an accurate test of it, as he unconsciously favors it at every opportunity. Then, too, we are very apt to make the mistake of comparing a new device or method with something which by no means represents the best that is known. It may be the best we know of, and in such cases we are not to be blamed, but unless it is compared with the best machine or method it has comparatively little value.

A concrete example is shown in a recent issue of *Grits and Grinds*, published by the Norton Company, where the costs of making crank shafts in a lathe, and by grinding are compared. In the first comparison, which was probably made by a man who intended to be perfectly fair, the cost of finish grinding was given as $38.40 for 600 pins, owing to the using up of a 24x2¼ grinding wheel and the wearing out of a diamond in truing this wheel.

This shows conclusively that he was not familiar with grinding, as the wheel was evidently unsuitable and more expensive than necessary, and few of us would think of using up a diamond in this way without investigating to see what was wrong.

Contrasted with this is the cost of the finish grinding of the same number of pins for both wheel and diamond, given at $5.65.

Leaving out the relative value of the methods, we see that something is wrong when the grinding cost in one case is over five times that of the other.

This is a very common mistake that we are all apt to make as we often make tests to the best of our ability and yet may be densely ignorant about some feature of it. We might, for example, test drills without realizing that thinning the point the right amount might make them cut with much less power, while a little too much grinding would weaken so that they would break very easily.

If we would only get the habit of separating our machining problems into operations and then consulting those who make machines for doing these particular operations, we would be money in pocket and everyone would be better off, to say nothing of having fewer worries and being able to enjoy life more, as we should.

Comparative tests are good things to know about, but it is a good plan to check them, item by item, to make sure the man who made them was not fooling himself.

It has been estimated by the Geological Survey that there is lost annually more than a million and a half barrels of oil by the burning of oil wells.

Unusual Crane and Radial Drill

Editorial Correspondence

A single-track, electric, traveling swinging-jib crane and its method of operating.

A radial drill that swings from a column in the shop and is used for countersinking large steel sheets; the sheets being moved back and forth on a gang of rollers.

Among the many interesting features in the shops of the Bucyrus Company, South Milwaukee, Wis., makers of steam shovels, dredges, etc., the two tools herewith illustrated are very prominent. These were made by the company out of angle iron, sheet metal, rods and other standard stock that was used around the shop.

In Fig. 1 is shown a single-track, electric, swinging jib, traveling crane that runs through the different gangways of the shop and out into the yard, as shown. Not over 2 feet of width in the gangway

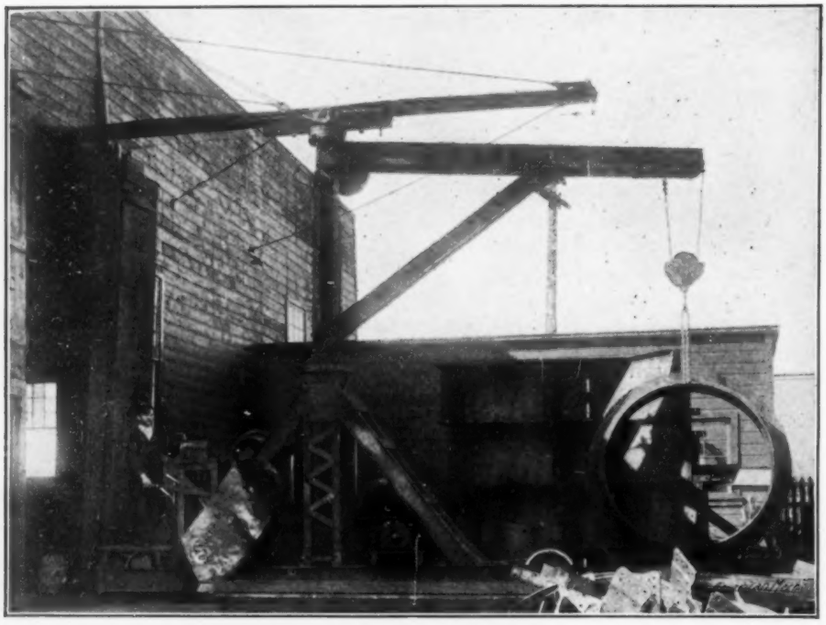


FIG. 1. SINGLE-TRACK ELECTRIC TRAVELING CRANE

is required for its practical operation, and, as can be seen, the entire framework was built of structural material.

A single track is run down through the gangway, and on this the crane is supported and runs on two wheels, one at each end of the frame. On the frame is mounted a motor with the necessary controls and it receives its current from an overhead trolley. The two wheels on which the crane rides are driven by chains and sprocket wheels, and the whole apparatus can be operated by a boy.

In Fig. 2 is shown a radial drill that the company built for drilling and countersinking large steel sheets. The sheets, as can be seen, are handled on a set of rollers held in a rack so that they can be easily moved backward and forward to the proper position for the required hole or holes.

The framework of the drill is composed of two [irons that are hinged to a post in the shop and fastened together so as to leave space enough between them to operate the drill carriage back and forth. A round bar is carried from the outer end of the [irons to a point considerably above them on the post; the angle at which this is set preventing the end of the irons from sagging.

The mechanism of the drill carriage that travels on the [irons and is guided is plainly shown. The lever by which the drill is operated up and down is a long one that carries the handle to the front of the rack of roller on which the plate is located. This is done so it can be easily handled by the operator. The lever for starting and stopping the drill is back near the post so it will be out of the way, as it is not often operated.

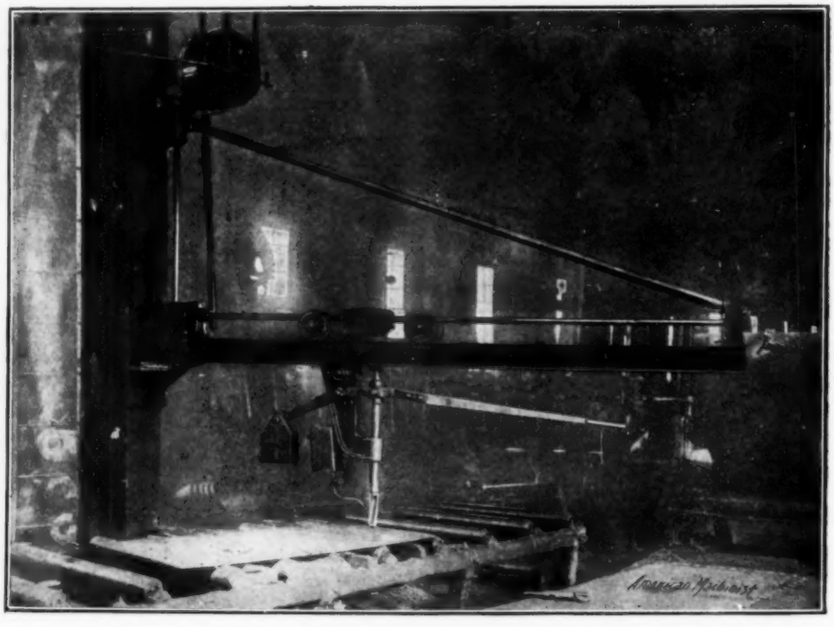


FIG. 2. HOMEMADE RADIAL COUNTERSINK DRILL FOR LARGE SHEETS

In a paper presented to the British Foundrymen's Association dealing with the growth of cast iron it was pointed out that various types of cast iron grew permanently in volume after being heated several times. In some cases the growth was as much as 60 per cent. The reason for this growth was the chemical reaction that took place between flame gases and the constituents in the iron, particularly the silicon constituent, which was changed into silica. Another cause at work consisted of the gases which were dissolved in the iron itself originally. These also reacted with the flame gases. As the result of this enlargement, the iron to a very large extent lost its metallic properties, and became practically useless. In order to insure that iron should not grow in this fashion, it was explained, that the silicon must be reduced to a very low figure, and there must not be any free carbon. The carbon must be chemically combined with the iron.

The Universal Milling Machine

By Luther D. Burlingame*

How the universal milling machine was invented in 1861-62 by Joseph R. Brown, of the firm of J. R. Brown & Sharpe. Its first uses and early successes. The patent, 46,521, was issued on February 21, 1865, and so far as known was always respected. The original machine still in existence.

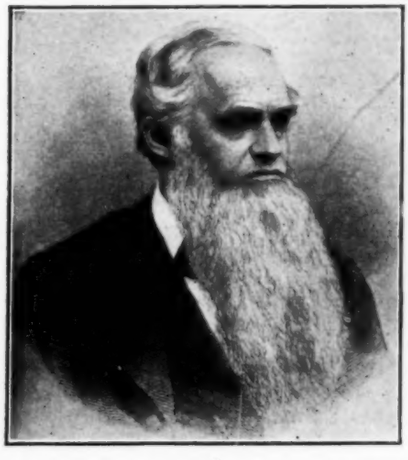
*Chief draftsman, Brown & Sharpe Manufacturing Company.

At the time of the invention of the universal milling machine in 1861-62, the equipment of an uptodate machine shop had for many years been considered complete when its list of machine tools comprised the lathe, the planer and the drill press. It is true that plain milling operations were at that time being used and that machines were being built for performing these operations, but these were in the main special machines adapted to a narrow range of work. The advent of the universal milling machine, however, added a new and important tool to the machine-shop equipment.

The Civil War, in spite of the great drain it made upon the resources of the country, proved a stimulus to development which was felt in many industries and the effects of which have been far reaching. The machine-tool industry was one of those which received the greatest impetus from that struggle. The universal milling machine, coming as it did at the beginning of this period of expansion, was one of the factors which played an important part in that development.

There were a number of machine shops in Providence which at the beginning of the war turned their energies to making war material. Among these was the Providence Tool Company, which established an armory and went into the manufacture of Springfield muskets for the Government. At this time J. R. Brown & Sharpe, also located in Providence, were manufacturing clockmakers' tools, yarn tools, scales and other small machinists' tools and had just commenced the manufacture of the Willcox & Gibbs sewing machine. They had already established a reputation for accuracy and reliability, as well as for ingenuity in doing whatever work came into their hands. Among the various parts of the Springfield musket was a piece called the nipple. As these nipples had to be made in large quantities, the Providence Tool Company placed an order with J. R. Brown & Sharpe to design and build a turret screw machine for making them. This screw machine built in 1861 was, I believe, the first machine tool made by the J. R. Brown & Sharpe Company.

There was a hole to be drilled in the nipple and I am told by James H. Anthony, who was at that time in the employ of the Providence Tool Company, that to do this drilling twist drills were used, these drills being made by filing spiral grooves in tool-steel rods or wire with a rat-tailed file. Mr. Anthony says that Frederick W. Howe, the superintendent, came into the shop one day and seeing a workman filing these grooves criticized the expensive method and set about at once to find a more economical way of making the drills. He visited the works of J. R. Brown & Sharpe to consult with Mr. Brown of that firm, in whose mechanical and inventive ability he had great confidence. (Fig. 1 shows portraits of Mr. Brown and his partner, Mr. Sharpe.) Mr. Brown appreciated at once the desirability of having a machine for grooving these drills and in his mind the need was emphasized because such drills were used in his own shop in the manufacture of the Willcox & Gibbs sewing machine. He must also have had a vision of possibilities of usefulness far beyond these limited needs, for he set himself to the task of inventing a machine which would not only cut the grooves of twist drills but would in addition be suitable for many other kinds of spiral milling, gear cutting and other work such as had up to this time required expensive hand operations to produce. Even with the foresight and vision as to future possibilities with which he undertook the design of this machine, it is doubtful whether he had an adequate conception of how epoch making it was to become. Little time could have been lost building the first machine as it was built and sold to the Providence Tool Company, March 14, 1862.



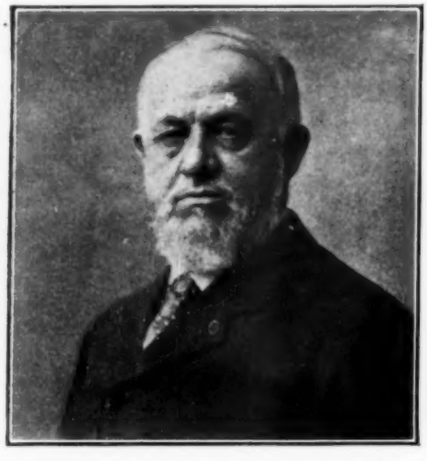


FIG. 1. JOSEPH R. BROWN AND LUCIAN SHARPE, OF THE FIRM OF J. R. BROWN & SHARPE, TO WHOSE INVENTIVE AND BUSINESS ABILITY THE WORLD IS INDEBTED FOR THE UNIVERSAL MILLING MACHINE

THE FIRST MACHINE

The first machine of a new type has special and growing interest for later generations as is shown by the care with which the first locomotive and steam engines are preserved. Fortunately this first

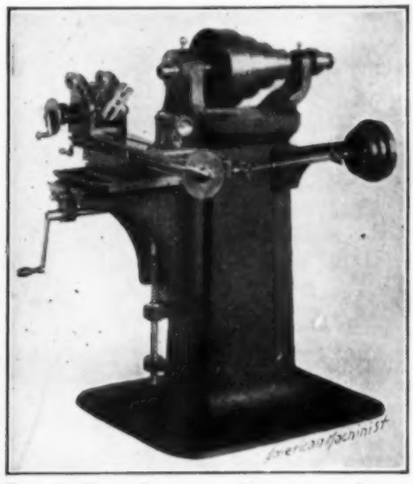


FIG. 2. THE ORIGINAL UNIVERSAL MILLING MACHINE BUILT IN 1861-2 AND NOW BEING PRESERVED FOR ITS HISTORIC INTEREST

FIG. 3. SILVER MEDAL AWARDED AT THE PARIS EXPOSITION OF 1867 TO J. R. BROWN & SHARPE FOR THE UNIVERSAL MILLING MACHINE AND TURRET SCREW MACHINE

universal milling machine has been preserved and after going through many vicissitudes has come back into the possession of its builders. After being used by the Providence Tool Company during the war, it passed into the hands of the Household Sewing Machine Company. It was purchased with other tools by A. B. Pitkin & Co., dealers, who sold it to parties in New York State. Again falling into the hands of dealers, it was finally placed in the shop of Samuel Moore & Co., of Providence, who were using it in their business of manufacturing jeweler's supplies, when the Brown & Sharpe Company searched it out and exchanged a new machine for it. The machine was still in good working condition when it came back into the hands of its builders. This was about the time of the Columbian Exposition at Chicago in 1893, and it was there exhibited, being given the place of honor among universal milling machines of a new line then just brought out. Among the visitors at the exposition was the toolmaker, Charles A. Eames, who first ran this original machine. He recognized it as an old friend and taking hold of the operating handles, put it through its motions while relating to those about him incidents connected with its early use. This machine is now being carefully preserved for its historic interest. Fig. 2 shows it as it was when it came back into the possession of the Brown & Sharpe Company.

The First Sales

After the building of this first machine, it soon became known that a machine embodying important advantages had been invented and a demand was created which taxed the then limited facilities of the J. R. Brown & Sharpe shops to supply. Ten machines were built and sold during the remainder of the year 1862. A list of the firms to which some of these machines went recall names familiar to old-time machinists. The first few machines went in the following order:

Providence Tool Company, Providence, R. I.; Trenton Locomotive and Machine Manufacturing Company, Trenton, N. J.; Starr Arms Company, Yonkers, N. Y.; William Mason, Taunton, Mass.; Amoskeag Manufacturing Company, Manchester, N. H.; Spencer Repeating Rifle Company, Boston, Mass.; Burnside Rifle Company, Providence, R. I.

There was a special demand for these universal milling machines in the various gun factories and 17 were sold to such factories during the remaining three years of the war.

During these years the sales were almost entirely in the East, showing that high-grade machine work was at that time confined almost entirely to the seaboard. Two machines, however, went west of New York State during this period, one of them to the Elgin National Watch Company, Elgin, Ill., the other to Gwyn & Campbell, Hamilton, Ohio. The first machine sold outside the limits of the United States went on June 24, 1865, to the North American Manufacturing Company, St. Johns, N. B., and the first one to go abroad went on Nov. 13, of the same year to Charles Callebant, Paris, France. From this time up to 1870, 20 of these machines went abroad into 12 different countries. These foreign sales were materially stimulated by the exhibit of this machine at the Paris Exposition in 1867, where it received the award of a silver medal, Fig. 3. I believe it is not easy to over-estimate the influence of this small exhibit by J. R. Brown & Sharpe as an entering wedge for the sales of American machine tools in foreign countries, coming as it did at a time when American machinery was little known abroad. These early machines going into famous continental machine shops gave such a favorable impression, both as to design and workmanship, that an avenue was opened for the extensive foreign business by American manufacturers which has since developed. That the J. R. Brown & Sharpe Company were alive to the importance of developing this trade is shown by the fact that they issued a catalog in French in 1867. It might be said in this connection that coupled with the inventive genius of Joseph R. Brown was the business sagacity and foresight of his partner, Lucian Sharpe, which had an important influence in bringing the products of his

A WEEKLY JOURNAL OF PRACTICAL INFORMATION IN ART, SCIENCE, MECHANICS,
NEW YORK, DECEMBER 27, 1862.
Improved Universal Milling Machine.
J. R. BROWN & SHARPE'S UNIVERSAL MILLING MACHINE

Fig. 4. First Published Illustration and Description of the Original Universal Milling Machine

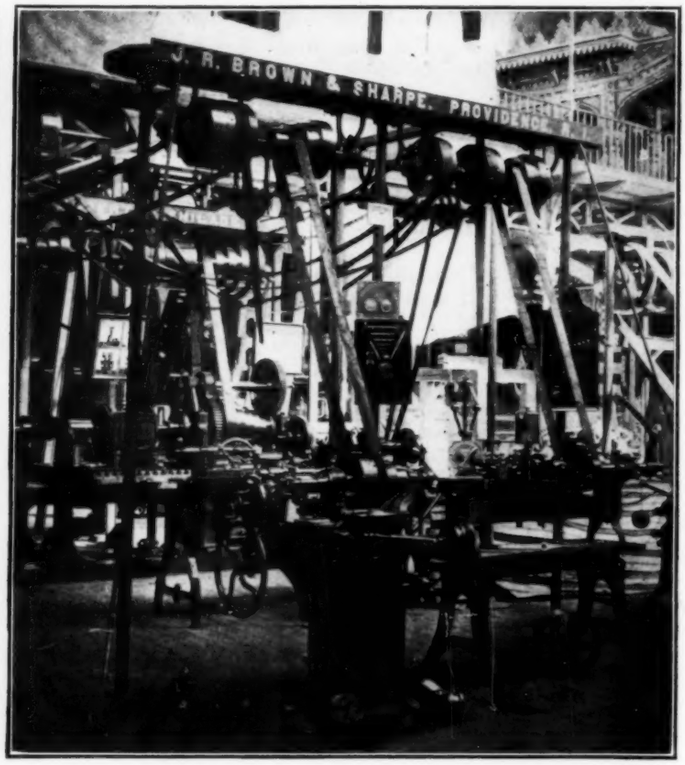


Fig. 5. Exhibit of J. R. Brown & Sharpe at the Paris Exposition of 1867. The First Public Exhibition of the Universal Milling Machine

company to the attention of the public and in securing for them a market. His influence, too, was always felt in maintaining the highest possible commercial standard of accuracy in all the work produced in the shops of his company.

The First Published Account

As far as can now be ascertained the first published account of the universal milling machine was in the *Scientific American*, Dec. 22, 1862. A part of the page showing this machine is here reproduced, as Fig. 4.

The earliest machines were made with babbitt boxes for the spindle and with the front bearing having the Schiele antifriction curve, which in those days was thought to have great virtue. They had practically all the vital features of the most uptodate, modern machines. In appearance they retained something of the architectural effect which was the fashion in the early designs of machinery, this being shown in the molding at the upper part of the column. In the main, however, the outlines are simple and direct, suggesting what has since become the established practice in the design of machine tools.

It will be noticed that the machine illustrated in the *Scientific American* has a "stop screw" for the knee which was not present in the original design. An additional attachment, which was later abandoned, is shown on the machines exhibited at Paris in 1867, Fig. 5. This was an attachment on the front of the column of the machine below the spindle which was, I understand, for use in milling irregular forms. A scriber was attached to the footstock so that it could be guided along a pattern of the form to be milled by the hand operation of the vertical and longitudinal feeds.

Attachments and Accessories

These early machines had an equipment of attachments and accessories, so complete as to indicate the thoroughness with which work undertaken by Mr. Brown was carried out. The swivel vise, center rest, chuck, collet, center with driving dog, special wrenches, etc., were all provided, even at this early date, as may be seen from the illustrations. The oldest drawings which have been preserved are dated Sept. 7, 1862. It is evident that there must have been earlier drawings or sketches, as a number of machines had been built at the time these drawings were made. One of these drawings is shown in Figs. 6 and 7.

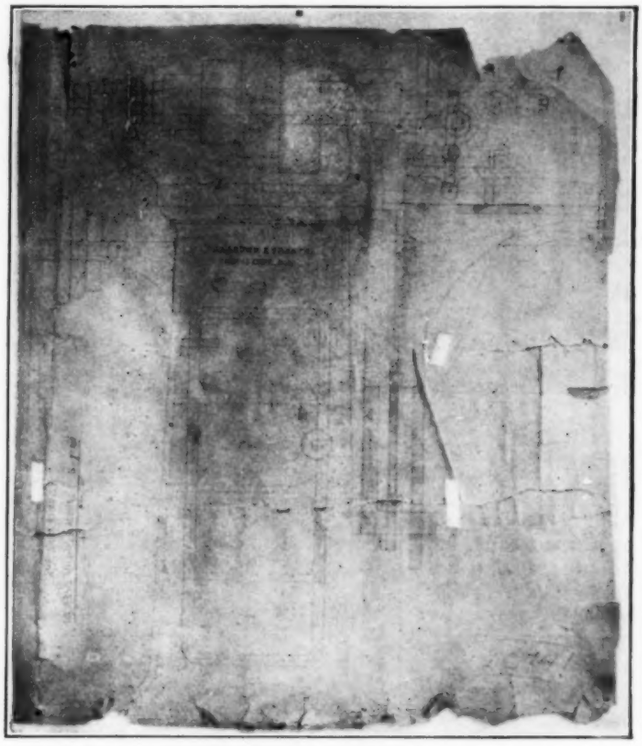


Fig. 6. Part of the Oldest Drawing of the Universal Milling Machine. Drawing Made on September 7, 1862

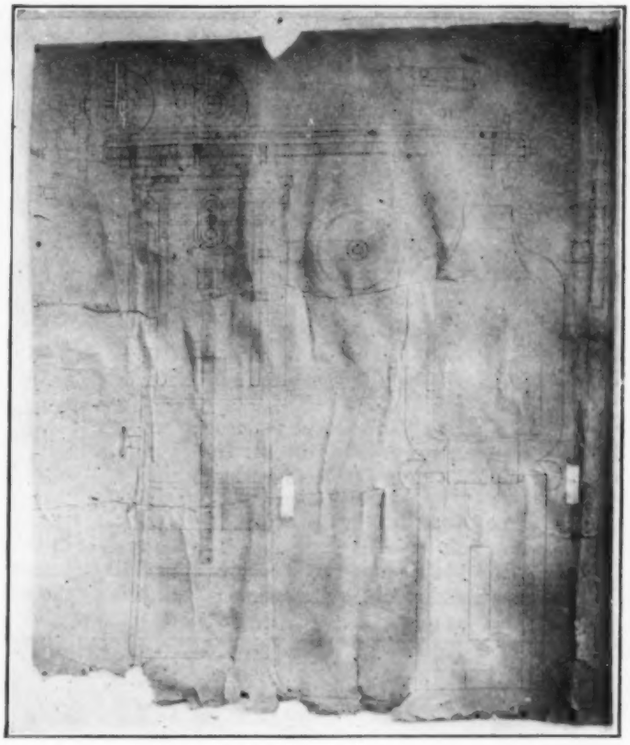


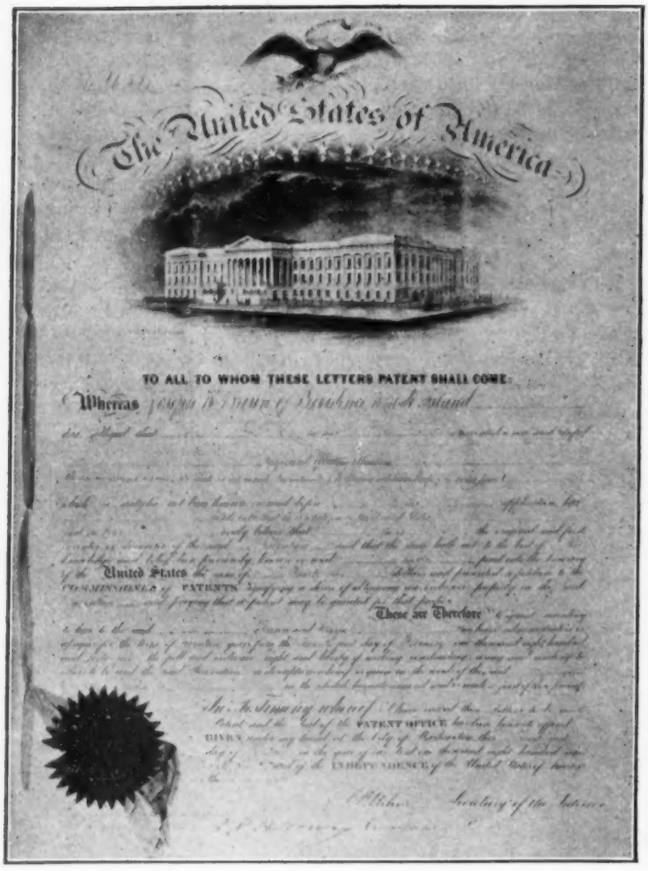
Fig. 7. Part of the Oldest Drawing of the Universal Milling Machine. Drawing Made on September 7, 1862

Mr. Brown's Patent

A patent was issued to Joseph R Brown, on Feb. 21, 1865, for the universal milling machine, which was basic in the ground covered by its claims and as far as is known was respected by other manufacturers, so that no attempt was made to evade or infringe it during the time it remained in force. The three claims of this patent each relates to a separate feature of invention. The first to a machine with a revolving cutter spindle having a knee, a cross slide and a swiveling plate carrying a sliding table; the second to the combination with a sliding table of a spindle (the spiral head spindle) which can operate to index and to cut spirals; and the third to the swinging block in the spiral head, allowing for the indexing of work when held at an angle. The specifications are clear and detailed as to the uses and possibilities of the machine, showing that these were recognized and well understood at the time they were drawn up. This patent dates back to the time when the specifications were made by hand on parchment and the drawings were hand-made tracings. The patent is of large size, being about 15x20 inches; a part of it is here reproduced in Figs. 8, 9 and 10.

A Large Machine

A larger size of universal milling machine was later brought out by Brown & Sharpe and first exhibited at the Centennial in 1876. This machine afterward went to Friedrich Krupp, Essen, Germany. The first machine of this size built, however, went to R. Hoe & Co., New York, on Sept. 15, 1875. These machines had overhanging arms for supporting the outer end of the cutter arbors, and were also provided with back gears, but were otherwise of the same general design as the smaller machine. Fig. 11 shows this large machine as it was first


The United States of America

TO ALL TO WHOM THESE LETTERS PATENT SHALL COME:

Whereas

These are Therefore

FIG. 8. TITLE PAGE OF PATENT ISSUED TO JOSEPH R. BROWN ON SEPTEMBER 21, 1865, FOR THE UNIVERSAL MILLING MACHINE

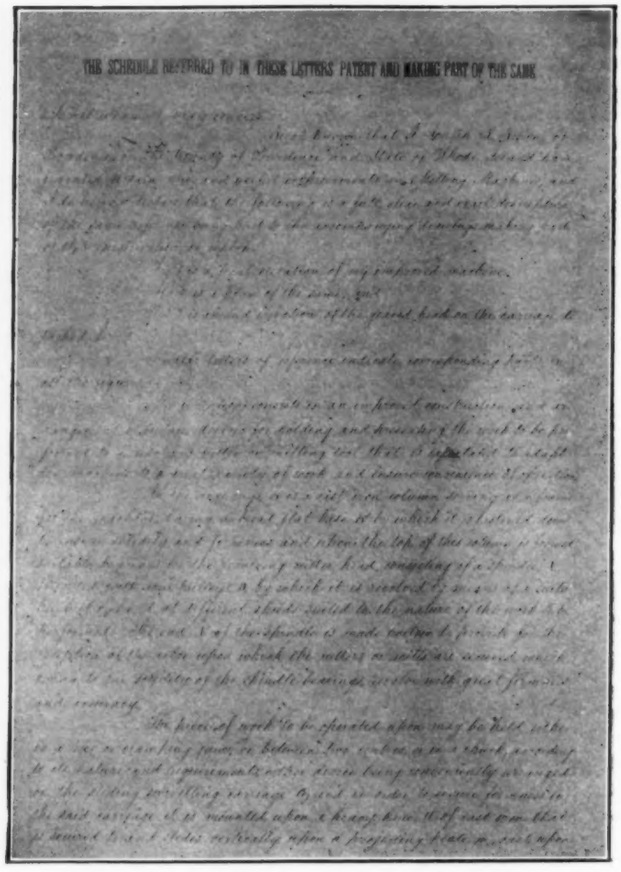

THE SCHEDULE REFERRED TO IN THESE LETTERS PATENT AND MAKING PART OF THE SAME

FIG. 9. A PAGE FROM THE SPECIFICATIONS OF THE PATENT FOR THE UNIVERSAL MILLING MACHINE. WRITTEN BY HAND ON PARCHMENT

illustrated and described in the *Scientific American*, of July 8, 1876.

As far as I know these two machines covered the whole range of the column-and-knee type of milling machines on the market at the time of the Centennial. The development since that time is indicated by the fact that aside from ma-

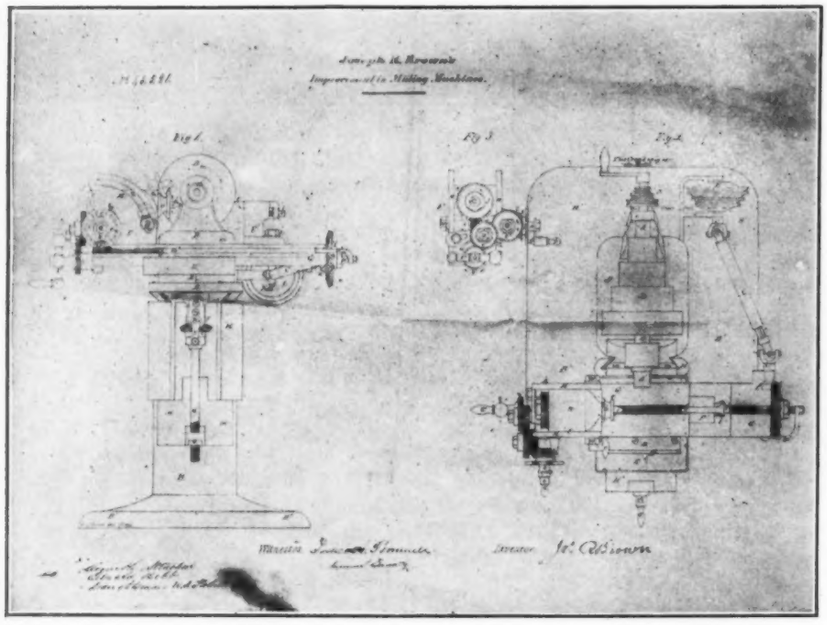
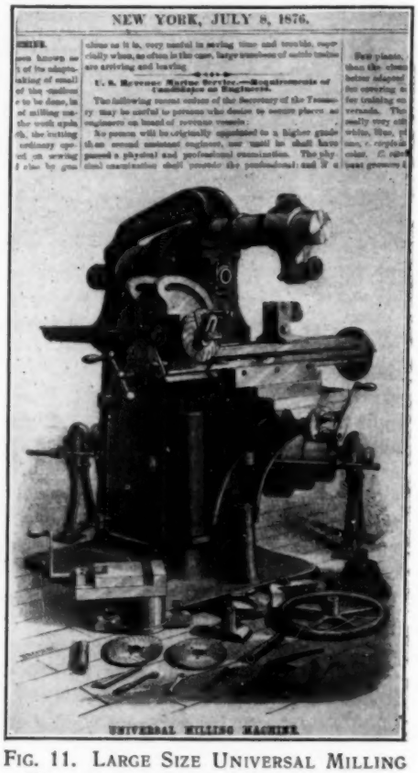

Improvement in Milling Machines.

Fig 1. Fig 2. Fig 3.

Witnesses: Inventor: Jos. R. Brown

FIG. 10. HAND-MADE TRACING ACCOMPANYING THE PATENT ISSUED TO JOSEPH R. BROWN FOR THE UNIVERSAL MILLING MACHINE. REDUCED FROM LARGE SIZE SHEET, 18x25 INCHES


NEW YORK, JULY 8, 1876.

UNIVERSAL MILLING MACHINE.

FIG. 11. LARGE SIZE UNIVERSAL MILLING MACHINE AS ILLUSTRATED AND DESCRIBED AT THE TIME OF THE CENTENNIAL EXPOSITION IN 1876

chines built by other makers, the Brown & Sharpe Manufacturing Company now regularly makes for the market 9 sizes and kinds of universal and 16 sizes and kinds of plain-column milling machines.

Almost from the start the universal milling machines were built in lots and while these lots were small at first, a principle was thus adopted which has been adhered to in the manufacture of all lines of machine tools since built by the Brown & Sharpe Manufacturing Company. This plan of manufacturing machine tools of standard type in lots is often spoken of as distinctively the American method as contrasted with building such machines to order only and of special design to suit the ideas of each customer. Accompanying the "American method" has also been the use of complete sets of special tools, jigs, fixtures, etc., used in the economical and accurate production of the machines.

Invention of the Formed Cutter

The invention of the formed cutter, which can be sharpened without changing its form, by Mr. Brown about the time he brought out the universal milling machine was another factor in the rapid adoption and increasing value of that machine.

Early Opinions of the Universal Milling Machines

It may be interesting to recall several among the many early testimonials regarding the universal milling machine, to show how it was regarded by those who first used it, and before its reputation had been established. R. S. Perkins, master armorer of the U. S. Arsenal at Frankford, under date of May 4, 1865, writes: "I am more than well pleased with it. It is invaluable in a shop like ours. It can be applied in so many ways that we should not know how to get along without it. It is one of the most perfect tools we have and ought to be in every machine shop in the country." Bement & Dougherty, Industrial Works, Philadelphia, Penn., wrote, on May 6, 1865: "We have had your universal milling machine in constant use since its receipt and find it invaluable; it being in practice all its name indicates, a *universal* machine. We find it especially useful in our tool room." F. W. Howe, superintendent of the Providence Tool Company, writes, on May 10, 1865: "I take great pleasure in recommending your celebrated universal milling machines which are all that their name indicates and are exceedingly useful for making machine tools of every description. Those we have had in use for the past three years are considered two of the most useful and profitable machines for making tools that we have in our armory."

Some years ago the American Machinist, in speaking of the progress in machine tools during the previous quarter century, said of the universal milling machine: "Probably no other single machine has exerted so great an influence upon the character of machine-shop and tool-room work as has the universal milling machine, and if it were to be banished from our shops their efficiency would be greatly reduced. It is the machine tool, which above all others has intelligence and brains worked into it and no other is capable of doing nearly so wide a variety of work. It will, within limits, do all the work of the driller, planer and lathe, besides doing a wide variety of work peculiar to itself, and which it is impracticable or impossible to do on any of the others named."

That this sums up the views held by the experienced mechanician of today, I believe to be true. I believe also that as time goes on and the importance of this invention is viewed in its proper perspective, it will stand out prominently among the epoch-making achievements in the mechanical world.

Making the Besly Tapper Tap

By M. E. Hoag

A tap-making process which involves different methods than those usually employed. The flutes are forged instead of being milled from the solid. Threads are milled on the lands with the proper relief, at one cut by several cutters.

A visit to the shops of Charles H. Besly & Co., at Beloit, Wis., brought to light some very interesting and novel operations in the manufacture of tapper taps.

The usual process of manufacture is to either turn down the shank, which wastes a large amount of steel, or to weld the tap body to the shank, which leaves a chance for breakage at the weld. Added to this is the milling of the flutes.

With the Besly process, the tap is fluted by swaging from the solid stock, which makes a considerable saving in steel and does away with the milling of the flutes. The gain which the makers consider of greatest importance, however, is the condensing and refining of the steel.

The steel used in these taps is of 130 points carbon, hard drawn, reeled and straightened, and is so tough that it is necessary to heat it before it can be cut off in the power shears.

The Operations

A 1-inch tap passes through about 24 operations, the more important of which are shown in Fig. 1, only a few of the most interesting ones being described in this article. Taking the blank at *A*, the first operation is the upsetting of the stock to form the body, *B*. In heating the blank for this operation a special furnace is used, which confines the heat to a very limited area, and leaves the end of the piece cool. This prevents the formation of a button.

This upsetting is done in an ordinary power press by the use of the dies shown at *B*, Fig. 2, which are held in a fixture fastened to the bed of the press. Two wedges attached to the ram operate on the dies, the first closes them and the sceond one brings a plunger against the end of the heated stock and forces it into the recess in the dies. The springs *C C* hold the dies open while the wedges are withdrawn.

The blanks are now passed to the swaging machines and pass through the successive operations shown at *C*, *D*, *E*, *F*, *G*, *H*, Fig. 1. A separate set of dies is required for each operation.

On 1-inch taps one man can perform from 1000 to 1200 swagings a day, or about 200 finished taps. Fewer operations are required on smaller work and the output is much greater.

Turning and Threading

The rough turning is done on an ordinary lathe in which a spring holds a roller attached to the cross slide, in contact with a steel form fastened to the taper attachment. This operation leaves 0.012 inch for finishing.

The finish sizing and threading is done at one operation in a special machine of very ingenious construction. This is shown in Fig. 3. The shank is held in a draw-in chuck, and the tailstock brought up against the end of the tap, which has already been centered. The end mill *A* sizes the tap; the cutters *B* follow, and complete the threading at one operation. The figure shows two cutters in use, a rougher and a finisher, but on some of the heavier work, three cutters are used, two roughers and a finisher.

Owing to the density and extreme toughness of the steel it requires 30 minutes to mill a 1-inch tap. The cutters, one of which is shown at *M*, Fig. 1, are made from Sanderson Double Special steel, ordinary high-speed steels having been proved unsuitable for this work, as they do not hold the fine points and cutting edges required.

The grinding of the flutes is done by hand, no automatic machine giving the

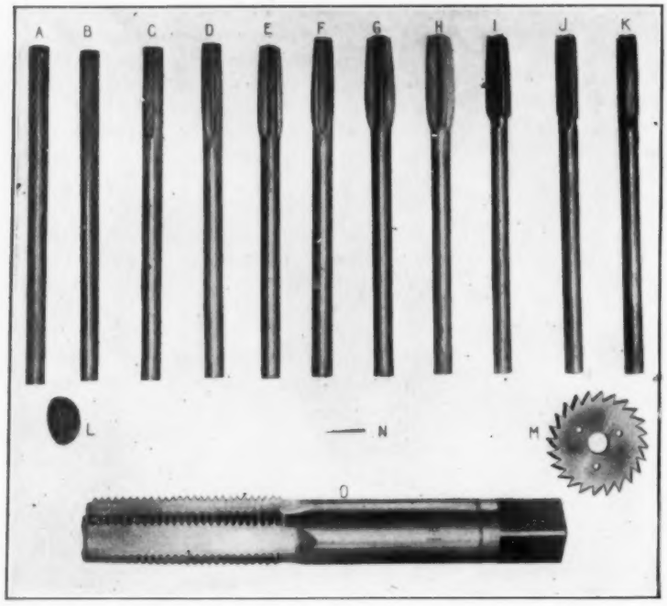


FIG. 1. THE DIFFERENT STAGES OF THE TAPPER TAP

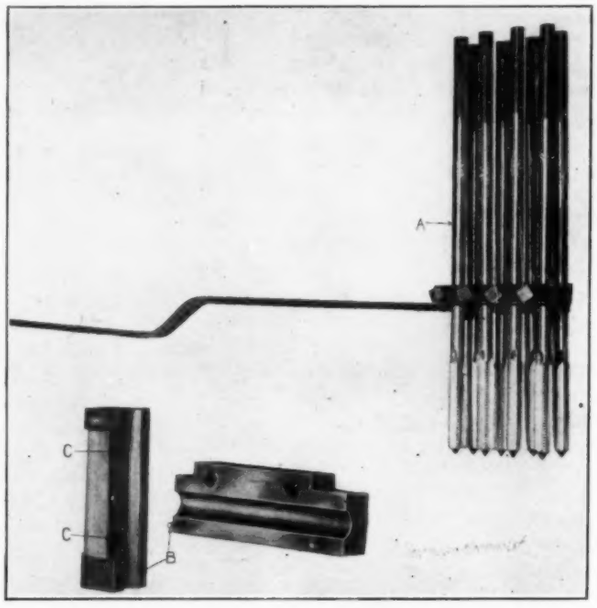


FIG. 2. UPSETTING DIE AND HARDENING CLAMP

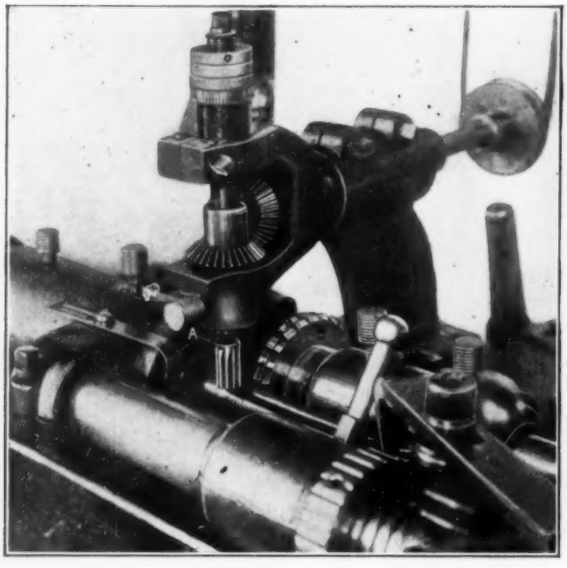


FIG. 3. SIZING THE TAP AND MILLING THE THREADS

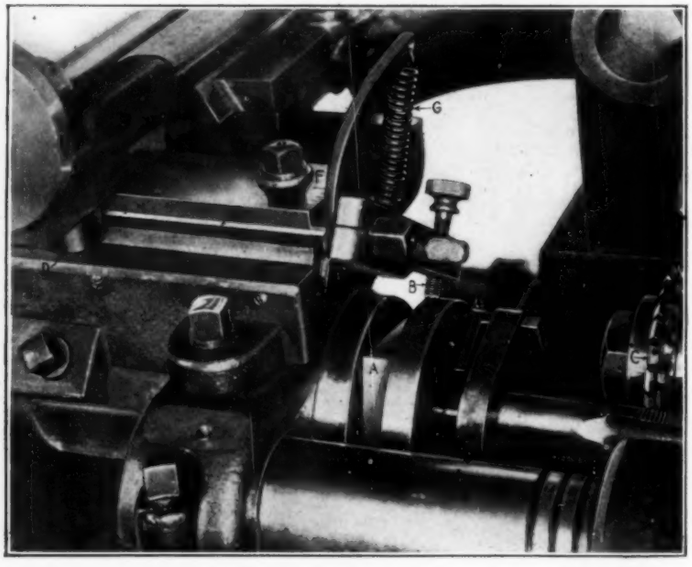


FIG. 4. MILLING TAPER-THREAD TAPS

results obtained by hand labor. One of the formed grinding wheels is shown at *L*, Fig. 1.

For heating and hardening the taps are held in the fixture shown at *A*, Fig. 2. They are first preheated in a lead bath, then passed into a second lead bath, the temperature of which is read with a pyrometer and kept constant, and from there to the hardening bath. The tempering is done in an oil bath, after which they receive the final grinding and inspecting.

TAPER AND BACKING-OFF ATTACHMENTS

In Fig. 4 is shown a combination taper and backing-off attachment that is used for threading pipe taps and other similar work.

In operation the hardened screw *B* rides on the square cam *A*, and is held in contact by the spring *G*. As the work spindle turns the cam raises the screw *B*, which in turn operates the rocker *E*, this pressing against the roller *D*, draws the cutters forward, thus giving the work an involute relief.

The tapering is accomplished by simply setting over the slide, the graduations of which can be seen at *F*. These machines are provided with micrometer adjustments throughout.

Some idea of the different sized taps manufactured in this plant can be had from *N* and *O*, Fig. 1; *N* being a No. 2x48, and *O* a 3-inch U. S. S. tap, used on bridge work.

The whole process is such a departure from the usual methods of tap making, that it is extremely interesting in every way.

The time clock may be used much more extensively than at present. Now the mechanic rings in in the morning and at noon and out at noon and at night. In the future, a time clock will be located next to the tool room and a man will be required to ring in the time consumed on various jobs. The time slip business is abused many times to the limit. If a time clock were used, the record would be made the instant the work was commenced and finished. A special time clock would be required which would print the job number in connection with the hour and minute.

The Boston Educational Convention

By Entropy

Comments by a contributor whose words always excite interest though not always approval.

Grasping my life firmly in one hand and my faith in publicly supported trade schools in the other, I went to Boston openly and braved the terrors of the society with the long name without disguise of any kind. I was recognized by several persons, but all of them forgot to repeat the correct formula before I escaped. Consequently I got away with my life and brought another handful of the said aforementioned faith.

To say that the meeting was a success in point of numbers, excellence of papers presented, in fact, in everything except ventilation of the various halls, would be but to repeat what has already been repeated by the press. To sum up the comments made in the lobby before and after the meetings is another matter, but not a difficult one.

It seemed to me that the society is nearly ready to get down to brass tacks.

Industrial Education an Established Fact

For years we have been listening to glittering generalities; now we are ready to say that industrial education is an established fact and that we are ready to discuss the details of its administration. Every form of education that has been proposed (with possibly one exception, of which I will write later) is being tried out. All are showing a measure of success and a place is being found for each. The continuation school, for the education in academic lines of men already employed in the trades, is being found the most generally applicable. It is really evening-school work done by daylight, and under the sanction of the employers to the extent that they continue to pay the boys or men wages during the time that they attend school. This plan is in use in Cincinnati, where 225 boys are receiving the training, and in St. Louis and Worcester, Mass., where about 60 boys in each city are following similar courses. It affords the least possible education that can be thought of with the advantage of low cost and, to the boy, of no loss of earning capacity. This latter item is a large factor, inasmuch as the earning capacity of most boys who would profit by this scheme is so low that any inroads upon it are very keenly felt.

The Trouble with Evening Schools

The question is frequently asked: "Why not give this work in the evening and then employers will not have to pay for any time?" I had an opportunity to see this work as it is being carried on in Worcester and also to watch the evening classes in the same city. The difference in efficiency is markedly noticeable. The day pupil is awake and keen, the evening pupil is sleepy and dull. Ten hours' work leaves a boy ready for bed or some relaxing amusement. To force his attention longer is unprofitable to both boy and teacher. The evening classes were well attended, but it is doubtful if the whole 200 evening pupils were taking away as much information as the 60 continuation pupils. The cost is low, about $20 per pupil per year in Cincinnati, $15 in St. Louis and practically nothing, so far, in Worcester, as the work had been shared by several instructors, in addition to their regular work and without extra compensation.

The Santa Fe Schools

The next plan in point of hours of attendance at school is the Fitchburg plan. A modification of this used on the Santa Fe railroad was discussed by F. W. Thomas, who is in charge. Apprentice schools are maintained in twenty towns, in twelve of which separate shop instructors are employed, that is, in eight places there are so few boys that the instructor is both a class-room and a shop instructor. It may be noted that wherever a private corporation has taken hold of this matter, they have sooner or later found the necessity, to say nothing of the desirability of separating the apprentice boys from the pourneymen to the extent of putting them under a separate instructor, whose duty it is to turn out thorough mechanics and do whatever useful work they may, rather than to turn out a maximum of work and whatever quality of workman they may. Boys on this road are paid good living wages, varying at different points on the line as the cost of living varies, and they are also allowed to make whatever they can on the regular premium plan in vogue in the shops. It is found that there is a negative per capita cost. In fact, after paying the boy the most liberally of any scheme of the kind that I have met, they put a profit of a hundred dollars or more per boy into their treasury each year. In the Topeka shop there are apprentices in the machine shop, on the erecting floor, the brass department, boiler, blacksmith, cabinet, pattern, coach and paint shops so that if a boy does not make good in one he may be transferred to another. He is given a six months' trial before it is suggested to him that he is a misfit, and it is very rarely the case that he does not either take the hint or brace up and win out. Few are actually dropped. Several of Mr. Thomas's instructors attended the meeting. They bore out his statement that he found young men best adapted to the work of teaching, in that they were best able to get in close sympathy with the boys.

The Matter of Teachers

This matter of teachers is one that is beginning to be a serious one. Everyone realizes that men who are masters of a trade are not plenty, and also that there are plenty of commercial jobs calling them. Even shop men, especially those who have tried it, admit that a knowledge of school organization and class-room work is desirable in a teacher, no matter how much practical knowledge he may have. A good shop man without that knowledge, who is required to handle as many boys as he must be asked to, if the cost of the school is not to be prohibitive, will become a victim of nervous prostration and withdraw in short order. Organization of skilled or unskilled men is a very different proposition from organization of green boys.

One of the speakers laid particular stress on the idea that it was the first duty of the head of each school to take capable mechanics and teach them how to teach. This presupposes that the head knows how himself and also that the head is an experienced educator. This in turn practically says that the head of the school shall not be a practical mechanic, for the number of such men is so limited that it is unlikely that they can be had, except in occasional instances. I ran across two directors of schools who are professional educators and who admit having no practical training. They are relying on their keenly analytical and trained minds to guide them correctly amid a multitude of counsels. It will be interesting to see how they succeed. I can imagine that the majority of your readers will consider that they will meet with still more counsel to enable them to decide which advice to accept.

The Importance of Experience in Teaching

Of course, there are always those who suggest that teachers could be readily had by sending a first-class academic teacher into a shop for six months or a year, and allowing him to "learn the trade." No comment is really needed unless it is for any craftsman to look back and see what kind of a mechanic he was six months or a year after he entered the shop. On the other hand, the mechanic who thinks he can teach if he can have a few months' instruction in teaching

should interview some teacher and get his viewpoint. From my own standpoint I should say that certain men are born to teach and can teach without training and that there are probably enough of them to meet the demands of the immediate present. No man can say that he was so born until he has tried it and no man ought to feel any the less well of himself if he fails.

The Machine Operator

The attention of the society was called very forcibly to the needs of a part of our population that has previously been neglected, by Mr. Howell Cheney, of the Cheney Brothers silk mills, of South Manchester, Conn. This is that large group, comprising two-thirds of our working population, who go at the earliest age that that the law allows into the unskilled industries. There they become mere machines, performing certain simple operations day after day, year after year, with no hope of advancement and with less and less ambition. They form a menace to our civilization socially and politically. Something should be done to give them an outlook above the things of the factory. It can only be done by continuing the work of the school beyond the fourteenth year, either by advancing the legal school age or by continuation schools. Mr. Cheney's paper was the gem of the whole meeting. He painted a picture of the conditions obtaining in any of the mill towns of the East without overcoloring it in the least, and he cleverly presented his view that in education alone lies the cure for that morbid condition of the human mind that arises from having nothing to think about, and which leads in the end to fancied injustice and then to anarchy. He would have men and women trained to think for themselves and then he would place before them things worthy of their thought. Strictly speaking this is not industrial education, for industrial education is education for the industries. Mr. Cheney's case is one where education in his particular industry is unnecessary, or so simple that he is able to give it without bother. It is, however, a case where supplementary education is a social necessity, and a case that ought to have the attention of every educator, whether industrial or academic.

The Preparatory Trade School

To return to the type of school to which I referred above as not having been tried. This is something of which I first heard from Carroll D. Wright, shortly before his death. I ought to say that John R. Back suggested the same thing so independently as to deserve to share in whatever credit there may be.

This scheme is to take boys at 14 years of age in a trade school and teach them the trade as a whole, not stopping for the perfection of the boy's skill, but rather teaching him *how* to do things in distinction from teaching him to *do* them.* Alongside this shop training would be placed a course in closely related mathematics, science, English, etc., calculated to give the maximum amount of both practical education and culture with the minimum amount of waste time devoted to mental discipline alone. This course would continue two years. At the end of this time the boy would be able to make anything that could reasonably be expected of the average journeyman, but he would not be able to make it with commercial speed nor, probably, with commercial exactness.

During the next two years the boy would be sent out to a commercial shop for, say, three-fourths of the time, either three weeks out of four, or three-fourths of each day, or three-fourths of some other unit of time. During that time he would be subject to the accelerating and refining influence of the shops as to speed and accuracy. He would know how to do his work so that the shop foreman would not have to stop and show him how, but would only have to attend to his natural function of getting out the work in quantity and quality to meet the needs of his employer. During the quarter of his time not spent in the shop he would have class-room work in continuation of that of the first two years.

The underlying idea is that the first two years are years of great receptivity and little thoroughness, owing to the nature of mankind. Instead of trying to reverse nature this plan supplements her. The last two years must be devoted to thoroughness in order to enable the boy, then just awakening to his sense of responsibility, to take his place among the workers. It is easy to believe that if the shop work of the first two years is guided by men who are able to earn their way in the shops and who have that fine essential to the success of this plan,—patience—then it will be possible for them to start the boys with right ideas as to methods and processes which they would carry into the commercial shops to the great gain of the latter. It is a radical proposition to suggest that a school may have a helpful influence on the shops of a community by acting as a clearing house of ideas, but I believe that it is more than possible.

Colonel Wright told me that a gentleman in Vermont was planning to leave a considerable amount of money for the establishment of a school of this kind. I believe that if the American Machinist would offer a reward for the capture of this man (alive), it might be possible to convince him that he should put the thing on its feet while he is still on earth to receive the credit due him.

Some one will undoubtedly look up some of the back numbers of the American Machinist and take me to task for being inconsistent. To any such I will say that the greatest objection to the Fitchburg plan lies in its inadaptability to the training of the beginner in the principles of his trade, that a foreman whose duty lies in getting out product is not in a position to turn out machinists from rough stock, but I do believe that he is the very man to take the boy after he has been carefully educated in the *how* and train him for the *doing* of things accurately and well.

*We understand that this plan is to be inaugurated in Cincinnati.—Ed.

A Place for the Professional Educator

As I see trade schools springing up over the country and talk with their people, I begin to have more and more of a feeling that there is a place in them for the professional educator or trained organizer, in the early months of the pupils' residence, to make a more gradual transition in his work from that of the grammar grades to the more practical work of the trade school.

The Absence of Manufactures

To get back to the convention: Two things were especially noticeable, one the disuse of the word "vocational" and the other the lack of attendance by manufacturers. For the latter there was no excuse, as the whole day Friday was spent in advancing their interests. The audiences were made up mostly of school people, professional educators mostly, in process of being reformed. This is one of the most helpful signs of the whole meeting, that the professional educator should have so entirely changed his view point during the past three years. That it is so is evidenced by the fact that I came away with my full crop of hair. I was backed up against the wall a number of times, but came away unscalped every time.

Call a Spade a Spade

As to the disuse of the word "vocational," the word was adopted a number of years ago by some people who did not possess the courage of their convictions, who did not dare to say trade schools. It never had a settled meaning among those interested and never meant anything to outsiders. A decent burial is all it deserved. Today we have the milder people who wish to apply the word "industrial" to a form of school which would not offend organized labor by teaching a trade, nor culture by too large a proportion of manual effort, nor the manufacturer by producing a valuable product, nor the pupil by making him work for his education, but by doing nothing at all would simply arouse the boy for two years and then turn him loose among the producers to sink or swim, as might be. Another three years ought to see the name "industrial" school wiped off the slate. If we want to teach a trade let's say *Trade*.

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Fixture for Automobile Water Pump

By C. T. Schaefer

A fixture having two cutter heads incorporated therein, and so geared together that but one setting of the fixture in the drill press is necessary.

Swinging arm carrying a sliding V-block for quick adjustment of rough casting.

The accompanying sketch shows a fixture for machining the inside of a water-pump body of the gear type. This fixture is used in the manufacture of American Mors engines by the St. Louis Car Company, automobile department, the pump being used on the 40-horsepower cars. The work is done in a drill press and in a very successful way.

Fig. 1 shows the complete fixture with pump body, yoke, and tool holders in position. Fig. 2 shows a top view of the fixture with yoke and tool holders removed, while Fig. 3 is a detail of the yoke only.

In Fig. 1 the tool holders are shown tapered to fit the drill chuck, standard Morse taper being used. Both tool holders have gears cut integral on them; in this way both ends of the body are finished by merely moving the cutter from one side to the other. Both gears have 25 teeth, giving a 1 to 1 ratio and the same cutting speed for both ends, the idea of this being to finish both ends of the body without resetting the fixture on the drill-press table. The tool holders have a fiber washer 1/16 inch thick, on both ends to take the end thrust, as well as being provided with two lock nuts to take up any wear that may occur through constant usage. The tool holders and the yoke form the upper port of the fixture and slide on the large guide pins *A*, which guide the cutters, the large bosses *B* acting as stops and determining the proper depth of cut. The dowel pins *H* are used for locating the bracket *C*, which in turn has a dowel pin *J* for locating the pump body in the fixture. The same dowel pin hole in the pump body is used to locate body on the bracket of the engine base, assuring absolute interchangability. In machining the body, the path of the outside diameter of the gears is machined, the balance being left rough as it is merely a passage way for the water.

The method of holding the work in the fixture is quite simple, but at the same time being a very novel feature. The body is placed in the fixture, locating it by the dowel pin *J*, this being located from the face of body in a previous drilling operation; then the nurled studs *K* are adjusted until the body is held tight against the tap of the fixture. The end movement of the body is controled by the V-block *D*, which is dovetailed and slides in the bracket *E*, the springs *L* being used to control the end movement of the block, thereby taking care of any variation in the rough casting.

The bracket *E*, carrying the V-block *D*, pivots in the fork *F* on the base of the fixture, this being done for two reasons; to permit the removal and insertion of the body and to take care of any lengthwise variation in the body.

A cam *G* is provided to lock the V-block in position, the cam having a taper side to give a small variation of adjustment, and having a handle for easy and quick manipulation. A hardened steel block is provided to relieve any wear that might be caused by the frequent operation of the cam. The large nut at this end of the fixture is also milled off at an angle, in order to provide for clearance in swinging the bracket *E* back and forth.

A great and labor-saving feature of

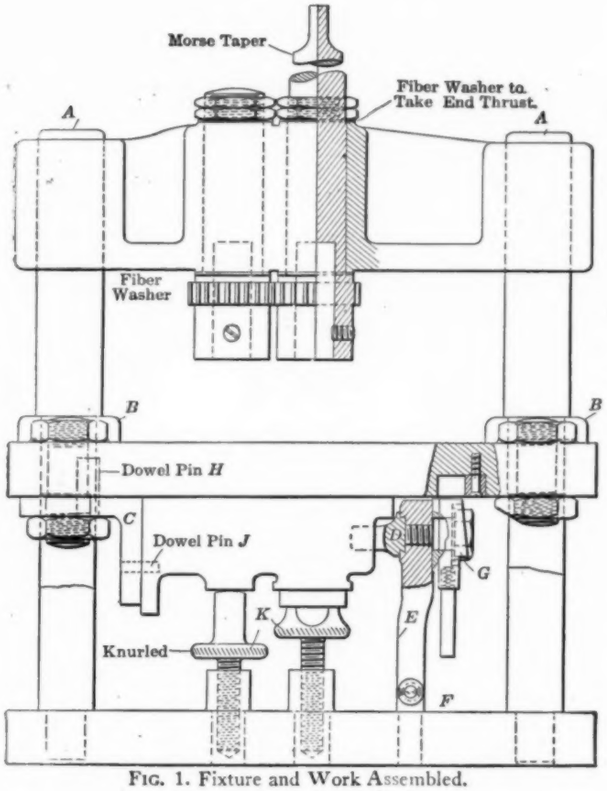

FIG. 1. Fixture and Work Assembled.

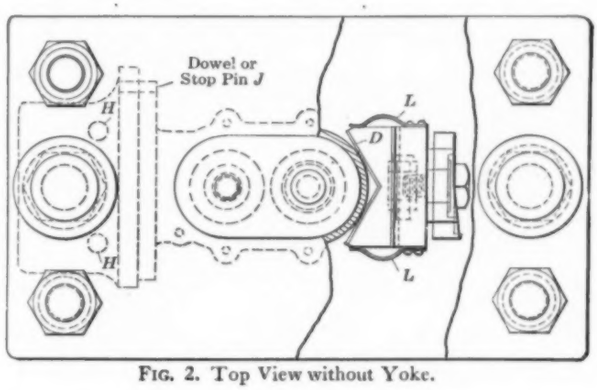

FIG. 2. Top View without Yoke.

FIG. 3. Top View of Yoke.

FIXTURE FOR AUTOMOBILE WATER-PUMP BODY

this fixture is that it is used without any wrenches whatever. This is quite an item, when the time lost in using wrenches is considered. In conclusion, I should state that this fixture is the result of considerable study along these lines, and the only fixture which has proved capable of taking care of the requirement mentioned above.

The Differential Piece Rate

By C. W. Adams*

The application of the differential piece rate to semi-automatic machines in a gear and chain wheel cutting department. On a job of 149 wheels the labor cost was reduced from the previous record of $39.70 to $20.09.

*Superintendent, Link-Belt Company, Nicetown, Penn.

Before entering into a discussion of this subject it will be necessary to give a short description, for those who may not be acquainted with it, of Fred. W. Taylor's differential piece-rate system of wage payment. Under this plan a fixed task is set, the time fixed being made up of two factors; the first is known as the handling time, or man time, the second as machine time. The handling time is determined by time study, the machine time by the maximum efficiency of the machine and tools. If the operator performs the task in the time set he is paid a price equal to the machine-hour base rate (the standard hourly rate paid on a certain class of machine), plus 35 per cent. This is known as the high rate. If he fails to perform the task set in the time allowed he is paid five-sixths of the high rate, or what is known as the low rate. The speeds and feeds and depths of cuts are specified on the instruction card given with each job, and on each time card the total time allowed, together with the high and low rate, is shown.

In the Philadelphia plant of the Link-Belt Company, practically all classes of work were paid for on the differential piece-work basis by the first of the year 1907, except silent-chain wheel cutting and gear cutting. At that time the above-mentioned work was still done under the old method of day's wage, and my attention was called to the gross inaccuracies of this method of wage payment by our silent-chain department, which complained of the differences occurring in the costs of drives. These differences occurred because of the lack of uniformity in the speeds and feeds in the various machines, and because of the failure of the operators to promptly report a job finished and to remove it from the machine. This last condition became manifest when the operator was running more than one machine. It was, therefore, a common occurrence for a time card to be held in the shop twice as long as it should have been. Constant attempts were made to have the cards turned in promptly, but the spirit of day-wage payment prevailed, and little improvement was shown. The operators on the gear cutters were dissatisfied because they were not allowed to work on a piece-work basis, as were most of the other men in the shop who were, consequently, earning more than they, showing that the antipathy and, in some cases, the actual opposition of the previous years to the introduction of piece work had disappeared.

Simple as the subject now appears, a suitable method of applying differential piece rates to gear cutting was not found until a year later. The difficulty lay in determining how many machines a man should be required to run. The size of the gear blanks varied to such an extent that it was extremely difficult to determine accurately how many changes would be made in each machine each day. The problem of the proper allowance for machining each job was comparatively simple, the length of run, feed and speed of the machine, number of cuts, number of teeth, and the handling or setting up time being the determining factors. The men were in sympathy with our ideas, gave us all the help possible, and cut the blanks at dictated speeds and feeds. During this time a series of time studies were made and it was finally determined that a man should run 3½ machines simultaneously, or, in other words, turn in on his time cards 3½ times as many machine hours as the number of hours he worked during the day. The following notice, which will explain the method of wage payment, was then issued to the men on the gear cutters and to the cost department:

METHOD OF WAGE PAYMENT ON GEAR CUTTERS. 1-4-'09.

The method of wage payment on the gear cutters is based on the assumption that an operator can run 3½ machines simultaneously; or, to obtain his maximum wage scale he is required to turn in 3½ times as many machine hours as the number of hours he works.

The machine-hour base rate equals the man's hour rate divided by 3½. The machine-hour base rate plus 35 per cent. equals the high rate. The low rate equals ⅚ of the high rate.

When starting work the operator is given a summary card, on which is recorded the total time worked at the gear cutters during the day. Together with the summary card the man is given a time card for his first job. The card is stamped "Out" when issued. As soon as his first job is in the machine he calls for his second job, and starts that, and continues throughout the day to call for as many jobs as he is able to place in the machines. He returns the card of each job to the window as the jobs are taken out of the machine.

All gear cutting is paid for by the differential piece-rate system. On each time card the time for preparation and the machine time is entered. To figure the piece-work price the time taken and the time allowed on all the finished jobs in a summary is summed up, and if the total number of hours taken is less than the total number of hours allowed, the operator is paid the high rate. If the time taken is greater than the time allowed the operator is given the low rate.

The time spent on unfinished jobs is paid for at the man's machine-hour base rate, and the amounts so paid are entered on the carry-over cards as money advanced. When jobs are completed that have been carried over from previous days, the amounts of money advanced are subtracted from piece-work price and the difference in amount is the money due.

If an operator on the gear cutters turns in a total of machine hours not equal to 3½ times the number of hours he worked on the machines, the difference between the number of hours turned in and the total number required will be paid for at the man's machine-hour base rate, and the total cost of these unexpended hours shall be distributed over the total number of machine hours turned in, but in no case are the amounts distributed to be considered as money advanced on unfinished jobs.

COMPARISON OF SAME JOB UNDER NEW AND OLD METHOD

Shortly after the foregoing notice was put into effect a comparison was made between the *time taken* and *wages cost* of cutting gears on the old day-work basis, and the *time allowed* and *piece-work prices* for cutting the same sizes of gears under the new piece-work method. One hundred and forty-nine wheels which were cut consecutively under the day-work plan were taken for a basis of comparison; on these jobs 322.4 machine-hours were expended, costing $39.70 in wages. The same number of wheels of the same size, consumed 188.1 machine-hours and cost $20.09 in wages when

done on the differential piece-work plan. The hours taken on day work were 71.4 per cent. greater, and the wages 97.7 greater than on piece work.

I believe that this method of applying differential piece rates to machines, a varying number of which can be run simultaneously by one operator depending upon the character of the work, is entirely original and new, and that it solved the problem correctly for the first time. D. V. Merrick, who had charge of the time study and rate setting in our shops at that time, was the originator of the idea, and developed it successfully, with the aid of the writer. Special emphasis should be laid on the fact that previous to the installation of differential piece work on the gear cutters the men had had special inducements offered them to increase their output and were working at a much faster pace than is customary with day workers—otherwise the savings effected would have been very much greater in view of which conditions the records made by the men will show up very favorably.

Heat and Cooling Treatment

By James H. Baker*

There is no mystery whatever about the heat and cooling treatment of steel and iron. It is as simple in principle as the freezing of water.

Wedding said long ago that slow cooling produced large crystals and that the opposite was true of rapid cooling.

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Some things this paper endeavors to show, are the benefits of treatment, the principle underlying the process, the danger of its being condemned on account of bad work, suggestions as to appliances, and a review of some statements. Let us term the operation "heat and cooling treatment," because if we omit the cooling part of the process we can get nothing except annealing, and we need more, vastly more, than annealing can give. In this paper let "treatment" stand for the entire process. It is almost presumptuous to write again about a matter of which there has been enough said to have it understood, if men would only stop—no, not stop but move—to consider what has been said, but such is human nature that things must be said over and over before the little world which should be interested will wake up and look at it.

Good concrete houses were built 50 years ago, to say nothing of ancient history, and yet it is only recently that the movement in this direction has taken a firm hold. A certain car-brake attachment, which is now universally used, went 20 years without being adopted. Men were talked at for years before they stopped sending all bills for merchandise, etc., three times through the mails, and even now many persons do not fold a letter in a sensible way.

It seems impossible for men generally to get a full understanding from a single statement, be it ever so clear, and so it is necessary to go over and over again the things we would have them understand. I leave out the matter of case hardening, another form of steel treatment, for in this there are so many modifications that it is a subject in itself. This paper is written to put the benefits of steel treatment in a plain and practical form and, if possible, to clear away the foolish and mysterious notions about it. There is no more mystery about steel treatment than there is about water freezing and thawing. No one would think of using an edge tool without hardening and tempering, and this is simply steel treatment.

Benefit of Treatment

The horse can work every day for years and thrive on it, or he can be worked to death in a day, depending on how much the work is below or above his capacity. Just so steel strong enough can stand up to service almost indefinitely, as against the same sized article that is too weak for its duty. To say that axes or springs need not be treated (tempered) is to say nonsense. To assert that the Government should not treat gun steel or armor plate would be to proclaim one's self fit for an insane asylum. To declare that cast iron should not be treated (chilled) for many purposes would be worse than childish. As the value of heat and cooling treatment is so universally conceded for so many things, why doubt it for many others. It may be safely reckoned that 50 per cent. in efficiency can be added to nearly all steels in either castings or forgings by good treatment. But this is nothing like what can be done by refined treatment; for instance, while the elastic limit of common steel may be raised from, say, 30,000 pounds per square inch to 45,000 pounds, it is quite possible to take higher-carbon steel, say, 0.50 to 0.60 per cent. carbon, having an elastic limit of 55,000 to 60,000 pounds, and raise it to 2½ times this, or 135,000 pounds elastic limit per square inch. And do not forget that when well done the reduction of area; that is, ductility, will be greater in the treated and stronger specimen than it is in the weaker, or untreated one from the same bar.

In automobile work the necessity for treatment of steel is widely, perhaps universally, acknowledged, and the finer the quality of steel used the more the importance of treatment is urged. In fact some makers of fine and costly alloy steels almost make it a condition in their sales that their steel shall be treated. It may be safely said one of the greatest benefits of some alloys is in rendering the steel more responsive to treatment.

In treating steel we get increased strength combined with increased ductility or toughness. It is quite easy to raise the ultimate strength or the elastic limit by simply hardening steel, but the reduction of area, or the ductility, would be very low and, consequently, the steel unfit for most purposes. It is said that the loss of ductility in hardening high-carbon steel is more than in low carbon. Of course it is, because the high-carbon product is the harder, and it is a fundamental law that hardness and ductility are two opposite conditions, and as one increases the other naturally decreases. The effect of treatment is to shorten the gap between these opposites.

Reasons for Treatment

Iron in all its conditions is subject to treatment, and it is taken advantage of from cast iron to the finest steels. The glass-mold maker who wants a dense, close material, takes pig iron which will not harden much and pours it in metal molds, or against cold metal surfaces, so that the hot metal will be quickly cooled, and he thus gets a compact state otherwise unobtainable. We are told about carbon in its hardening state and in its cement state, all of which is much like talking about water in its freezing state and in its nonfreezing state. For practical purposes let us understand that steel when heated to a certain degree and quickly cooled will harden, just as water will freeze at a certain temperature. Again, we hear of part of the carbon in a given piece of steel changing to the cement state and part of it breaking up into crystals, etc. It would be as appropriate to speak of a part of water changing into freezing water and part of it into nonfreezing. In either case it is the iron, steel or water which changes as a whole, and these fine distinctions do not distinguish.

The foundation of susceptibility to change by treatment does not lie in the carbon, but in the iron. Norway iron, one of the purest in the ferro family, is, if possible, more responsive to treatment than some carbonized irons, or steel. This material, if heated and cooled in a certain way, or thrown down at a certain heat after forging, is one mass

of coarse crystals. But when rightly treated it becomes beautifully fibrous. Hence, with the same results in cast iron with its 3 per cent., or more, of carbon as in this carbonless product, we see that the reason for treatment lies in the iron. With the necessity for the treatment of even the best and purest iron thus clearly established, there could be no safer foundation laid for heat and cooling treatment. Many people seem to forget that much steel is less than 1 per cent. from being pure iron. Of course, carbon and other elements modify conditions. Howe and others have pointed out many very interesting things brought about by differing proportions of carbon, and other elements, but this does not change the general law.

Review of Some Things

Wedding said long ago that slow cooling produced large crystals and that the opposite was true of rapid cooling. This is true and it is unfortunate that this simple statement was not left stand unclouded. After all the philosophizing about large crystals in large bars and small crystals in small bars, this is only another illustration of what the rate of cooling does, because it is impossible to cool the large bar as rapidly as a small one. As to the changes in steel by slow or rapid cooling, etc., intelligent steel men know the quicker steel is cooled the closer its grain will be, and the harder it will be, and the slower it is cooled the softer it will be, other things being equal. Anyone may demonstrate these things by heating two pieces of steel to a bright red, cooling one suddenly by quenching and allowing the other to cool slowly and then breaking the pieces and examining the fractures. The different treating heats for different wrought steels do not cover a wide range, the rule being that the lower-carbon steel requires, or at least will stand, somewhat the higher heat, this range being from 1300 to 1400 degrees Fahrenheit. But for many steel castings a "tool steel" heat would avail nothing. It is well understood that below a certain heat steel cannot be changed materially in structure, just as making water cold time and again will not form ice unless a freezing temperature is reached.

In order to get the best condition from heat treatment the steel should be cooled as quickly as the size and contour and the kind of steel in the article will admit and then drawn by heat, or tempered, to suit the purpose intended. For many purposes high-carbon steel properly treated so as to give a tensile strength of say, 100,000 pounds per square inch, would be much better than a lower-carbon treated so as to give the same strength. It is fortunate that the lower the carbon the more quickly the steel can be cooled without damage to it.

One writer of prominence says that "it is improbable that quenching should originate crystalline structure" and there is a good deal said about crystalline structure which is formed while steel is coming to a hardening heat. The fact is that this has nothing to do directly with it. When steel is at a certain heat it has no more grain or crystalline structure than so much wax or taffy, and if it could be cooled instantly, absolutely instantly, there would be no grain or crystalline structure. In the treatment of steel I attribute no importance to time of holding the proper heat when once attained. But if for reducing the carbon, and effecting other chemical changes, or for increasing the carbon, as in case hardening, then the heat must be maintained for some days, and for case hardening, some hours. But I do mean that the material should be heated as evenly as possible, and this means more or less slowly.

Practically no change is made in steel worth talking about so far as its crystallization is concerned, without heating it up to the recalescence point. But nothing can be done without influence, and possibly the slightest heat affects steel, but so slightly that it cannot be detected. When it comes to tempering it or reducing the hardness, any degree of heat counts. It may be asked why not heat a piece of steel hot enough so that when cooled it will become just hard enough for the desired service. This cannot be done because practically speaking the range between the two temperatures which will harden and not harden is too narrow to take advantage of. Again, why not choose steel with just enough carbon so that when heated and hardened it would have just the hardness desired? If the hardness alone is all that is wanted this can be done, but good edge tools could not be made in this way.

Pyrometers

Pyrometers have come to be a very important factor in connection with heating steel, because this subject has so increased in importance that there had to be means found for gauging the heat, and pyrometers meet this want. But please remember that there are pyrometers and pyrometers and that some pyrometers will only maintain their efficiency a short time. Where the need of a pyrometer is for laboratory work only a fine instrument can be used all the time, but for factory work, instruments of more common make and of lower cost can be used by keeping a correct one for use in checking the others up. This is mentioned because some furnaces should have several instruments used in them all the time. In this checking work if a given instrument should be found, say, 40 degrees above or below the standard, this would be noted on it and the operator would then deduct or add to its readings accordingly. For fine work a pyrometer which depends directly on the electric current, generated in itself, by the heat of the furnace, to move the indicating hand is not correct. This objection becomes less as we go into the higher registers. An instrument should be used in which the indicating hand is moved by an independent current, because when the heat is low the current generated in the pyrometer itself is weak, and when the heat is high the current is comparatively high, and so far as I have observed this does not give correct readings. In other words, the current generated by the furnace heat, be it ever so weak, "pushes the button and the outside, uniform current does the rest." (This, too, is a subject which would make a separate paper.)

This service is being elaborated constantly, for instance one large concern has a woman sitting at a keyboard from which she directs the heating at many furnaces according to the instructions laid down by the manager of the tempering department. There are different kinds of steel being handled at the same time and the operators go by an indicator set by the person at the keyboard, and who is noting on a diagram what is being done. This tends to correct working and preserves a record of the treatment of each particular kind of steel. But to these precautions must be added care in the disposition of the "fire rods" or points of the pyrometers, for often furnaces vary much in heat at different parts of the hearth, and also in different vertical zones.

Objections to Treatment

In view of the foregoing, why do some intelligent men denounce the heat treatment of steel? Simply because their experience has been with material which was not treated intelligently. It may be asked, if the process is simple, why was it not done right? Nothing can be done right without proper care. Some men seem to have about as much discrimination as the doctor, who after a mishap, from a certain disease, wrote in his little book: "Apple dumplings will cure a shoemaker but will kill a tailor." There are cases in which the treatment of a steel article might be a damage, not because treatment damages steel, but on the contrary, because it benefits it. For example, if an article was of such a shape that we could not treat it uniformly in all its parts it would then, in point of service, be an unsymmetrical article, whereas before it was a symmetrical one in relation to the strains to which it would be subject. Therefore, there are articles for hard service, which should be made of special steel and used without treatment, because then the quality of the steel would be the same clear through. In other words, if the shape of an article is such that it cannot be evenly treated, but the conditions of service are such that it must have the metal in the same

condition throughout, then this condition should be primarily sought in the composition of the steel rather than in any treatment of it.

The importance of proper designing is not decreased by bettering the condition of steel, but rather emphasized. Suppose a long spring bar fixed at one end and its load vibrating at the other. If properly designed and of uniform condition it will have equal action throughout. But if a part only of it is made stronger, the action or bending stress will be concentrated at one point and the spring will not last, for making part of it stronger in this way made it worse as a whole. Poor work and a lack of adaptation is the answer as to why some condemn steel treatment.

Causes of Bad Work

The most general, and perhaps the main cause for poor work is bad furnace construction, and this is often aggravated by improper application of the fuel. In fact, some forms of fuel can hardly give the best results, gaseous and liquid forms being highly preferable, because they can be applied more directly where needed in the furnace, and usually will supply a more uniform and controllable heat. I hold no brief for any interest, but let me say that when making up specifications and arranging to see that they are safeguarded, consult the testing laboratory and inspecting engineer, for they are the signal stations along the line, and without them the car of progress must come to a stop or move very slowly. But do not expect these men to bring you information as to how your competitor is reaching results, for no honorable man will do this.

Recently the head of a testing laboratory told me that unless something radical was done, steel treatment would be severly discredited. The inspecting engineers have every opportunity to see the difference in results and so know whereof they speak.

One of the things to be done is to see that furnaces are built to do uniform work, or else an inspector should constantly be watching operations, and then select the most unpromising specimens for test. Poor work does not necessarily mean that a proportion of a given lot of work is bad so much as it means a lack of uniformity. One bad car axle in a thousand is too many.

Something, perhaps, should be said in relation to costs. These, of course, will vary with the size of the article, the heat to be attained, and whether the article is to be heated more than once. And too, there will be a great variation in the matter of fuel cost, owing to different fuels used and the nearness to, or remoteness from, the home of these fuels. There is one splendid fuel, however, which seems to be very widely distributed over the country and whose cost for heat unit is low and is fairly equal at most points, and that is oil.

"Definitions" Once More

A benefit would be conferred if someone would coin a word which would intelligently stand for "heat and cooling treatment," and which would divorce it from "annealing." The American Machinist has been looking for this word, and I am told that automobile people are hunting it too. If this word has not been found I suggest that a word which denotes "hardening and tempering" be chosen, for this is just what it is. Such a word would do much to set forth its reasonableness.

The words ohm, volt, ampere, etc., came from the names of men who made discoveries and helped forward developments in electrical science. Now, as there has lived a man who devoted much thought and labor to steel treatment, and who was called from labor to rest in the very bloom of his joyous life, and whose labors have so helped on this great improvement, why not give his name to this treatment by the word "coffinize," in recognition of John Coffin?

As now used, many terms are without definite meaning and often the only way to understand what a writer means is to have a description in detail of what he did in any case referred to. This is especially true of "annealing." Samples of what we hear are something like the following:

1 You say you hardened the article. What did you do? A. I heated it and quenched it.

2 You say you tempered this article. How did you do it? A. I heated it and cooled it in oil.

3 You say you oil tempered this article. What did you do? A. I hardened it and then tempered it by using hot oil to reheat it.

4 You say you tempered this article. How did you do it? A. I heated it, cooled it so as to harden it and then tempered it by reheating.

5 You say you treated this article. What did you do? A. I heated it, cooled it and then reheated it.

6 You say you air hardened this article. What did you do? A. I heated it and laid it in the air to cool.

7 You say you annealed this article. What did you do? A. I heated it and laid it out in the air to cool.

8 You say you annealed this article. What did you do? A. I heated it and let it cool in the furnace.

9 You say you annealed this article. What did you do? A. I kept it hot three or four days packed in oxidizing material.

10 What did you anneal this article for? A. To give it a finer grain and toughen it.

11 What did you anneal this article for? A. To soften it.

12 What did you anneal this article for? A. To take the casting or forging strains out of it, that is, change physical conditions.

13 What did you anneal this article for? A. To remove parts of the carbon and change chemical conditions.

Therefore, in view of the foregoing, if you ordered an article in steel and specified that it should be annealed, and it came to you in a coarse-grained and brittle condition, you would have no recourse even if the maker had heated it after making, though only enough to take out strains and not enough to give it a fine condition. Castings were coming from a steel foundry too soft and we told the concern we wanted them harder. "Oh," they replied, "then you don't want them annealed." We said, "Dash the word 'anneal,' but if you mean by 'annealing' to heat the steel so as to give it a finer grain, then we want you to so heat it, and then cool it in such a way that it will have the requisite stiffness." In other words, experience leads me to feel sure that there are numberless instances in which men do not understand what is needed and the use of the word "anneal" does not help them.

Now, after what I have said about the simplicity of iron and steel cooling, just as water freezes, and that there is really no mystery about the matter, let me emphasize beyond the possibility of any reasonable doubt that we can dismiss all the mechanical metyphysics which would make a mystery of steel treatment and come to rest on the solid rock of fact that, all other things equal, the more quickly steel is cooled the finer its grain. In other words, I repeat that steel at a certain heat has no grain, and it only has one when cold, because the rate of cooling gave it time to form. If asked what would be the physical condition of steel cooled instantly it can be stated that it would be at its best. But, of course, this supposes that it would be tempered to suit the intended service. This may be easily demonstrated by slicing a piece of steel, say, 1/32 inch thick from a bar 2 inches thick, heating both to a proper and equal temperature an quenching in the same medium and the difference in condition will be found to be so decisive as to make the demonstration perfectly clear. I will even go further and say that you might cool the larger piece in water or even brine, and cool the smaller piece in a slower medium, say oil, and yet the difference would be very clear. But in connection with this, in order to avoid accident, let me too repeat that the rate of cooling allowable is determined by the "size and contour and the kind of steel in the article." Thus, I have tried to sum up the simple facts underlying steel treatment, and once for all to wipe out any ground for supposing there is anything mysterious or unreasonable involved in the best of steel treatment.

A Handy Core Print Cabinet

Every patternmaker knows the advantage of having plenty of core prints on hand ready to be used on any job that may require them, instead of stopping to make them as wanted in each case. In too many cases, however, the supply of extra core prints is kept in boxes under the bench or in similar inconvenient places and it becomes very difficult to find them when they are needed. In fact, it is often quick and cheaper to make a new one than to hunt out the exact size required.

To overcome this difficulty, John R. Gledhill, 107 Friendship street, Providence, R. I., long ago made the cabinet shown in the accompanying illustrations for use in his own shop. In this way he not only finds any core print he desires without a moment's loss of time, but can also see at a glance when his supply is running low and have it replenished when one of his men has a little spare time.

The cabinet shown is very cheaply constructed, consisting of fourteen movable shelves let into the sides of the cabinet, each shelf having pieces fastened to the ends and the back to prevent core prints being pushed off and making it very easy to handle any shelf separately. It is only necessary to pull out the shelf containing the desired size of core prints, either just enough to get at the front row or to remove the whole shelf, and the amount of time saved will repay the cost of a cabinet of this kind in a remarkably short time.

Each shelf is plainly marked with the size of core print it contains and the whole cabinet is kept in a corner where it takes up practically no room; it was simply placed on the bench shown for convenience in securing these photographs.

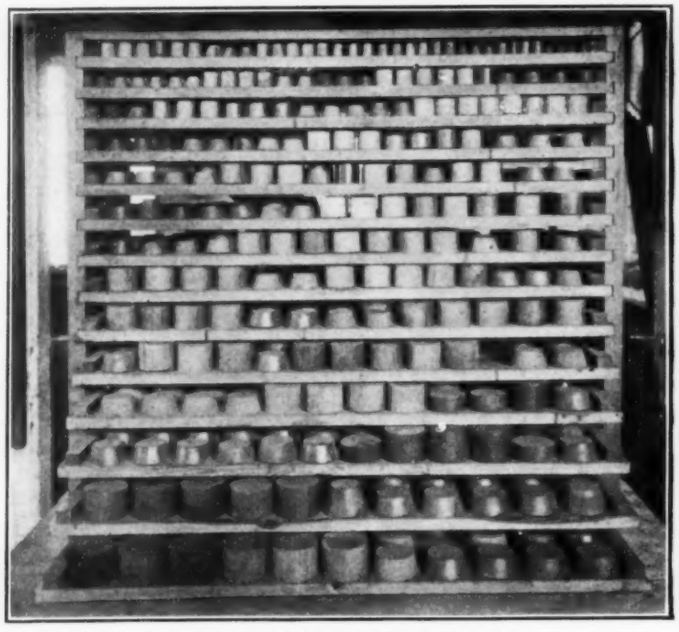


FIG. 1. FRONT VIEW OF CORE CABINET

FIG. 2. ANOTHER VIEW OF CORE CABINET

Spacing Device for a Press

At the Fore River Shipbuilding Company, Quincy, Mass., a large number of channel-shaped sections are made to hold the buckets of marine steam turbines. In the bottom of each channel-shaped strip, a series of holes is punched to receive the milled ends of the blades. These holes are quite close together and must be very accurately spaced in order to bring the finished blades of the turbines in the proper relationship with one another. In order to get this spacing quickly and accurately, a device, shown in Figs. 1 and 2, has been developed and has proved successful.

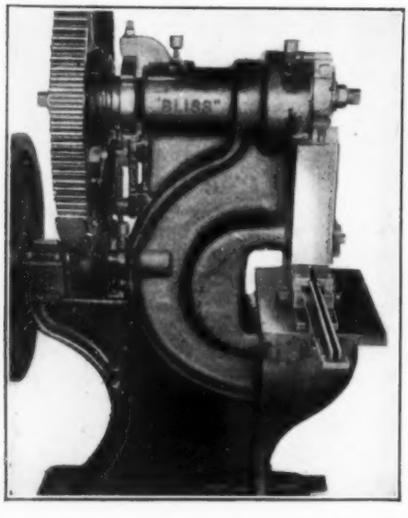


FIG. 1. SPACING DEVICE FOR A PRESS

The punching fixture itself is shown in the press, see Fig. 1, and the spacing device, which is nothing more nor less than a thin piece of sheet steel, punched with a series of holes corresponding with the series to be punched in the channel-shaped strips, is seen in Fig. 2. The method of attaching this strip to the piece to be punched is plainly shown, one end of each being caught in a suitable clamp. In the punching fixture itself, or, more properly, in the die part of the press tool is a spring pin, that engages each hole successively in the guide strip and thereby locates the channel piece for the holes that are to be punched in it. The device is simple, effective and inexpensive.

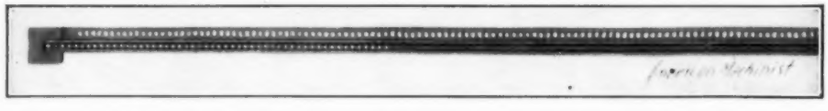


FIG. 2. SPACING STRIP ATTACHED TO A CHANNEL STRIP

In England, King Charles II, in 1660, closed all the Sussex and Kentish iron works, as it was feared that the oak trees would be used for charcoal and there would be no oak for war vessels. He did not foresee that in later years the oaks would be of minor importance in the building of ships.

Manufacture of a Bottle Cap

Special Correspondence

Details of an ingenious lock-screw bottle cap, automatic, semi-automatic and hand machines for attaching it and the fully automatic machines for producing the completed cap including making and inserting of the tin-foil clad packing disk.

While this article is to deal more particularly with the manufacturing problems and automatic machinery developed for its production, it is necessary at the outset to indicate the characteristic feature of the bottle and jar cap. This novel feature of the cap is that it constitutes a *lock screw*. The screw threads on the side of the cap are formed around screw threads on the bottle itself, these threads on the bottle acting as a matrix. Prior to forming these threads a locking tongue on the cap enters a notch formed in the bead, around the bottle's neck, thus rendering it impossible to remove the cap with breaking this tongue, thereby destroying the seal, and guaranteeing the authenticity of the product contained within the sealed bottle or jar. At the same time the cap can be screwed back upon the bottle, making an airtight reclosure for the temporary preservation of the contents after a previous opening.

Both the cap and machinery for producing and applying it are the invention of A. Wilzin, of Saint-Ouen (near Paris), France.

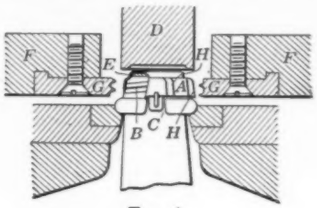


FIG. 1

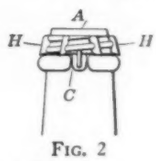


FIG. 2

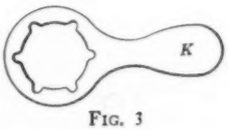


FIG. 3

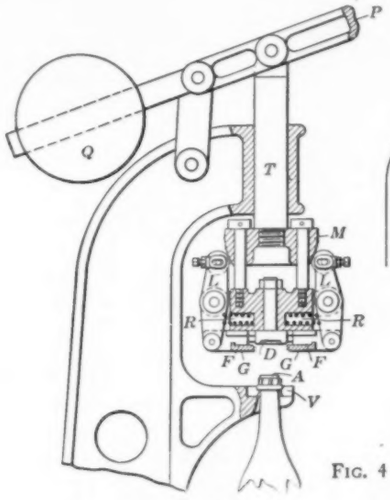


FIG. 4

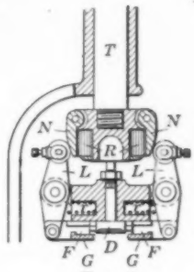
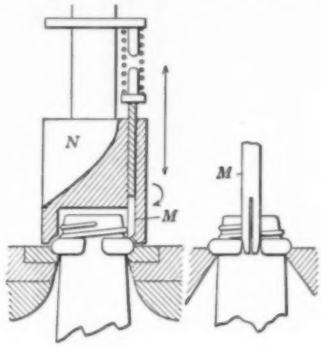


FIG. 5



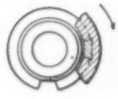


FIG. 8A

American Machinist

DETAILS OF BOTTLE CAP AND TOOLS FOR ATTACHING

The product of the operation shown in Fig. 1 can be seen in Fig. 2, which shows the neck of a bottle with a cap attached.

Turning now to the illustrations, Fig. 1 shows a Wilzin cap *A* placed over the screw-formed end of a bottle neck *B*, with the locking tongue of the cap entering the controlling notch *C*, thus being in a position for the chuck *D* to exert pressure on the top of the cap, making a tight joint against the end of the bottle through the medium of the packing disk *E*, and while this pressure is maintained the jaws *F*, carrying on their inner edges plates *G*, formed to a counter part of the thread on the bottle are formed inward and form the metal of the sides of the cap around the bottle thread, and completes the operation of attaching.

Vertical hollow ribs *H* will be noticed stamped in the side of the cap. These permit of an increase or decrease in the diameter of the cap as well as equalization under the action of the jaws in order to adapt a standard size and shape of cap to the variations in size and shape that occur in glassware. Furthermore, these vertical rims facilitate unscrewing by means of a flat key *K*, Fig. 3, made to engage with them.

Turning now to Fig. 4 we see the principal constructive details of the closing head, with a modification in Fig. 5, rendering the action of the jaws elastic in order to compensate within reasonable limit for deviation from "round" in the necks of bottles and jars. By means of these heads axial pressure is brought to bear upon the cap, pressing it firmly against the end of the bottle mouth.

In Fig. 4, when the slide *T* is brought up to cone *M* by means of springs interposed between it and the head carrying jaws, it first carries down the slide head so that chuck *D* presses on cap *A*, after which the compression of the interposed springs causes *M* to approach the closing head and thereby the levers *L* oscillate on their fulcrums, causing the jaws *G* to approach the center, thereby pressing the threads into the cap. The plan view of the head in Fig. 4 indicates this set of jaws and levers *L*.

In Fig. 5 the solid cone *M*, shown in Fig. 4, is replaced by six cone sections *N* pressing against the rubber ring *R*, so that each one of the six jaws *G* may advance independently, more or less, toward the center, according to the irregularity of the jar or bottle neck. The resistance of rubber ring *R* is such as to permit the indenting action of the jaws *D* against the sides of the cap.

The principles of these heads are worked out in three types of capping machines, shown in Figs. 6, 7 and 8. In all of these machines the bottle instead of being supported on its bottom, is held suspended by the spherical collar at the neck. This insures level pressure on the packing and mouth and eliminates all risk of breakage and unsatisfactory results, from the fact that bottles hardly ever have the axes through mouth and bottom in line, besides the bodies may be irregular and out of shape. This form of support serves for any length and shape so long as the mouth remains the same.

Fig. 6 shows a hand-operated machine for limiting production and places not provided with power.

Fig. 7 shows a motor-driven machine adapted to apply from 5000 to 8000 caps per day. Here the cap is placed over the mouth of the bottle by hand, the bottle is then inserted into the machine, the machine is treadled and the closure made.

Fig 8 shows the type of automatic capping machine. The filled bottle is presented to a pair of semi-circular jaws which grip it beneath the collar and carry it toward the device shown in Fig. 8a.

This device acts in the following manner. Supposing the bottle to be placed in the support with the notch as shown in Fig. 8a, a spring finger *M* will find itself pushed up by the full portion of the collar until the revolution of *N* causes it to come opposite the notch and drop into It, whereupon it carries the bottle with operator, and it thereby becomes unnecessary for the operator to pay any particular attention to the placing of the bottles.

From whatever position the bottle may be presented to this device it is automatically turned about its vertical axis, if necessary, in order to present the underneath the closing head, stops and is subjected to axial pressure and simultaneously side pressure forces in the threaded dies and the closure is completed.

The closed bottle is automatically pushed out, preferably upon a belt carrier.

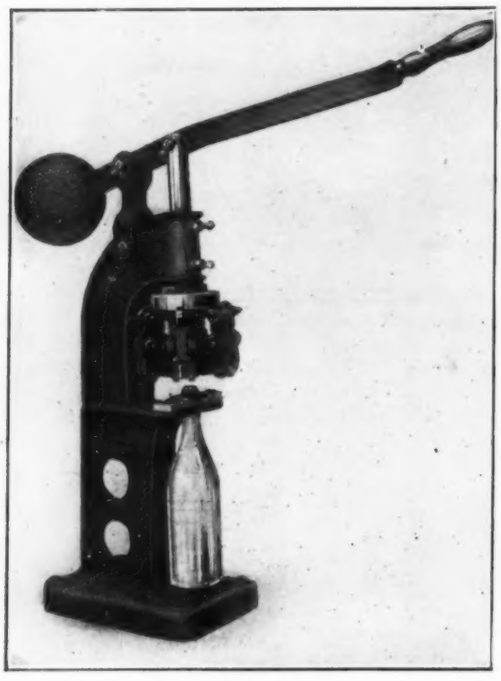


FIG. 6.

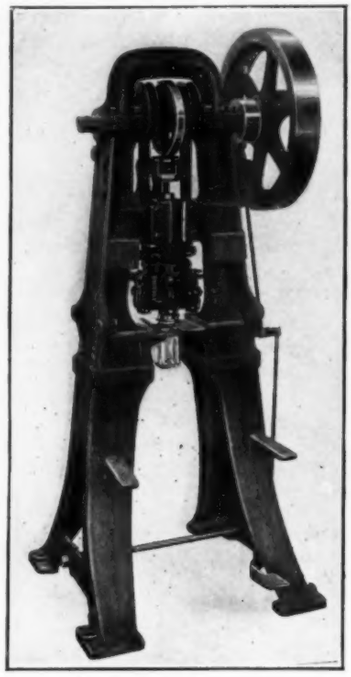


FIG. 7.

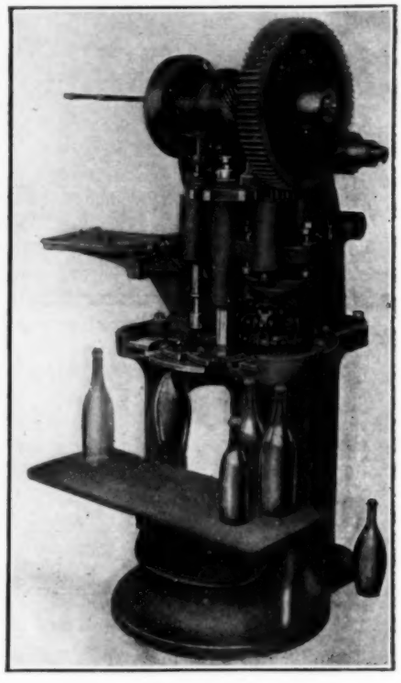


FIG. 8.

THREE TYPES OF CAP-ATTACHING MACHINES

it until its regular stopping place is reached, which stopping place is always in front of the operator. In other words, *N* makes a complete turn at each stroke of the machine, and whatever be the position of the notch when placing the bottle, this notch is always carried to exactly the same position in front of the notch in the collar beneath the threaded portion of the neck, in such a position that the locking tongue of the cap will enter. The caps are fed automatically down an inclined chute and placed on the bottle as the bottle passes along. See Fig. 14. (If no bottle is in position a cap is not fed.) The bottle then passes

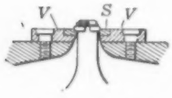


FIG. 9

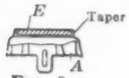


FIG. 9A

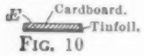


FIG. 10

FIG. 12

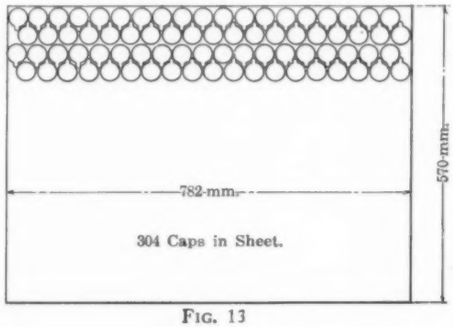


FIG. 13

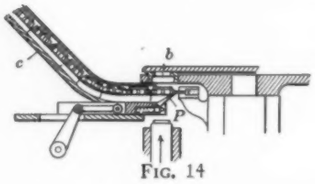


FIG. 14

FIG. 15

FIG. 16

FIG. 18

American Machinist

DETAILS OF BOTTLE CAP AND ITS MANUFACTURE

The feed is limited only by the operator's skill and will average between 35 and 40 bottles per minute.

Mention has been made of the packing disk. This may be of any substance desired although to complete the process a supplementary machine produces a packing disk made of cardboard or wood fiber, covered with a thin sheet of tin foil. This is cheaper than cork, has the advantage of not contaminating the liquid by adding a corky taste, and is hygenically safe as chemically pure tinfoil is acknowledged to be the best and most hygienic substance for inclosing food products which alimentary science has yet developed.

MANUFACTURE OF THE CAP

Fig. 11 shows a machine designed and built to manufacture the one-inch cap with the composite cardboard or wood fiber and tinfoil packing that has just been described. This machine is fully automatic. The full sized sheet of tinplate as it is taken out of the box, or comes from the printing press is clamped into a carrier moved by the operator on the division liners, on which an automatically actuated pin stops the carrier in a correct position, before each stroke of the press, see Fig. 13. A quadruple

combination of die punches and formers produces four caps, see Fig. 12, carries them up to the punch and ejects them at the top of a stroke in a double channel, whence an automatically actuated comb or pushing device moves them along in two lines, by means of a horizontal carrier, shown behind the press into the finishing machine. This machine manufactures the packing disk and introduces it into the cap.

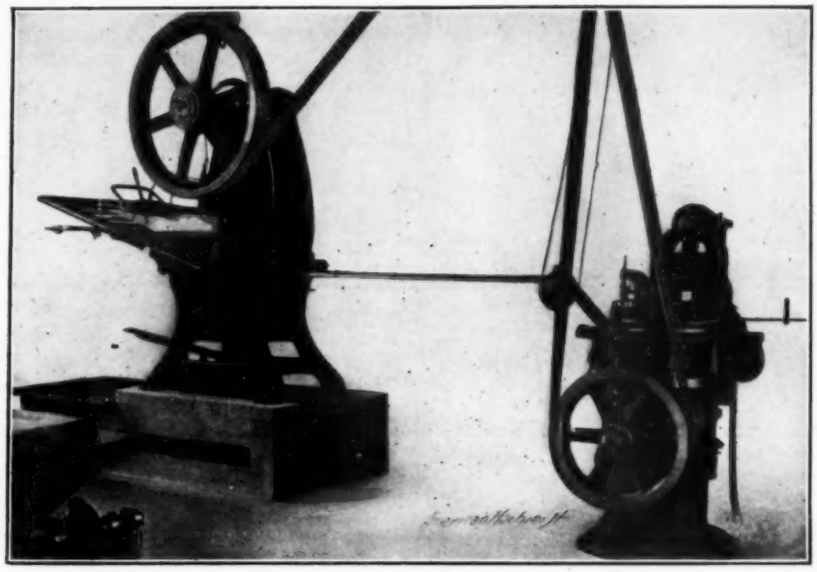


FIG. 11. CAP-MAKING MACHINE

The tin plate used for the one-inch cap and the economical way in which the layout is arranged, in order to have as little waste as possible, are shown by Fig. 13.

At the end of the horizontal carrier into the packing disk, making and introducing machine, the caps descend into an incline chute and are pushed, two at a time, by means of automatically actuated pawls beneath the dial plate into bushings in the manner indicated by Fig. 14. This dial plate always presents them two at a time to the action of a series of tools, which, acting simultaneously, accomplish a series of operations on the 28 caps that are contained in the dial. At each stroke two completed caps drop out of the machine.

The caps first stop above two slides which contain the packing disks, manufactured in another part of the machine. These slides stop underneath the caps, the disks are then automatically raised and pressed into the cavity of the cap, the disk carriers descend returning to the position where two more disks will be manufactured and placed in them while the dial carries forward the two caps with disks already in place and stops over two tools which contract the edges of the cavity containing each disk, so as to insure their being held very firmly, thus preventing their dropping out during the course of transportation and application.

The caps thus prepared are brought by the next turn of the dial above two tools which slit the tongue, Fig. 15, then above two tools which stamp a stiffening rib on it, Fig. 16; the combination of this rib with the slit being attended to assures the breaking off of the controlling tongue, when lifting it out of the notch before unscrewing the cap from the filled bottle or jar.

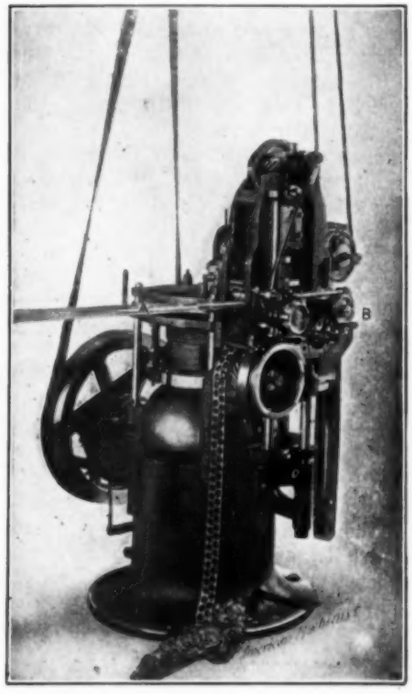


FIG. 17. MACHINE FOR MAKING AND INSERTING PACKING DISKS INTO THE CAPS

Adapting Tracks to Different Railway Gages

The railway from Mukden to Pekin and thence to Honkéou is of normal gage, viz., 4 ft. 8½ inches, while the meter gage has been adopted for that which serves the coal-producing district of Chan-Si. In order to avoid transhipment, bogie-wagons have been constructed of such design that the gage can be varied to suit either road. Two types of bogies are in service. In both cases the wheels are pressed on the respective ends of telescopic axles, each provided with four bearings. In the one type the wheels are capable of revolving independently, the bearings being so spaced as to make a continuous axle unnecessary. Here the keeping of gage, whether normal or meter, is entirely dependent on fixing, by means of movable cotters, distance pieces sliding in sleeves attached to the respective sides of the framing. Two of these distance pieces are provided, the one vertically over the other, at the center of each bogie, the sleeve for the upper one being supported by helical springs in such manner that the upper distance piece, which also carries the wagon, is capable of a limited vertical motion as the springs deflect, owing to the irregularity of the track. In the other type the axles, although telescopic, are so constructed that the inner part can be expanded by means of a conical wedge, operated by a screw and thus made virtually solid at any required gage.

A single central guide, somewhat similar to the upper distance piece in the design first described, is provided, and a species of parallel motion is adopted in order to prevent the unequal telescoping of the two axles. A latch is introduced at each end of the bogie, having notches in it to suit either gage, and the wedging of the axles is not attempted until the latch falling into position shows that the bogie is of the right width. To effect the change of gage the wagon is run over a tapered length of track, the attachments maintaining the gage of the bogie having previously been cast adrift. The length of the tapered portion of track is 262 feet, and the total time required to effect a change is 5 to 6 minutes. It is pointed out that for the service in question a large mileage will be covered for each change of gage, and thus the wear of the telescoping parts will be relatively unimportant.

According to reports from Washington electric locomotives will be used for towing ships through the Panama Canal locks. The locomotives will be gear-connected to the track by a middle rail cut into the form of a rack in order to obtain the requisite tractive effort.

Humphrey Internal Combustion Pump

By Edward N. Trump *

An entirely new departure in the realm of the gas engine, the only moving parts being a reciprocating water column, and a few automatic valves, eliminating piston, crank shaft and flywheel.

By high initial compression, expansion of gases below atmosphere and absence of mechanism, efficiencies considerably exceeding those of the Otto cycle are attainable.

Applications to all kinds of power apparatus.

*Chief engineer, Solvay Process Company, Syracuse, N. Y.

The Humphrey gas pump is the invention of Herbert A. Humphrey, of England.

The Humphrey pump, for heads up to 35 feet, is simple; just a piece of pipe with a stand pipe at one end and an explosion cylinder at the other, the latter surmounted by a few simple fittings which, by their intermittent motion, show that the thing is really alive. It is nevertheless one of the most interesting inventions which has appeared to astonish the engineering world since the advent of the dynamo, and I believe an account of what I saw of it in a recent visit to the experimental plant of the Pump and Power Company, at Dudley Port, will merit the interest of the readers of the AMERICAN MACHINIST.

Fig. 1 is a diagram of the simple pump tested by Prof. William C. Unwin, as is recorded in a paper by the inventor read before the Institution of Mechanical Engineers, in England. It consists of a conical explosion chamber *C*, fitted at the top with an inlet valve *I* and exhaust valve *E*, and a scavenging valve not shown in this view. A simple interlocking gear is arranged between these gas valves by which, when valve *I* opens and closes it locks itself shut and releases valve *E*, and when valve *E* opens and closes it locks itself shut, releasing valve *I*. Consequently, each time suction occurs in the chamber the gas valves open in turn.

Imagine a charge of gas and air to be compressed in the top of chamber *C* and fired by a sparking plug, which projects through the top casting. All the valves are shut when explosion occurs, and the increase in pressure drives the water downward in the pump and sets the whole column of water in the discharge pipe in motion. The column of water attains kinetic energy, while work is being done upon it by the expanding gases, so that when these gases reach atmospheric pressure the column of water may be moving at, say, 6 feet per second. The motion of this column of water cannot be suddenly arrested, hence the pressure in *C* tends to fall below that of the atmosphere, the exhaust valve *E* opens, and also the water valves *V*. Water rushes in through the water valves, mostly to follow the moving column in pipe *D*, but partly to rise in chamber *C* in an effort to reach the same level inside the chamber as exists in the suction tank.

When the kinetic energy of the moving column has expended itself by forcing water into the high level tank, it comes to rest and, there being nothing to prevent a return flow, the column starts to move back toward the pump and gains velocity until the water reaches the level of the exhaust valve, which it shuts by impact. A certain quantity of burned products is now imprisoned in the cushion space C_1, and the energy of the moving column is expended in compressing this gas cushion to a greater pressure than that due to the static head of the water in tank *ET*. Hence a second outward movement of the column results, and when the water reaches the level of valve *E* the pressure in the space C_1 is again atmospheric, and further movement of the water opens valve *I* against a light spring, drawing in a fresh charge of gas and air. If there were no friction, the water would fall to the same level as that from which the last upward motion started, but the amount of combustible charge drawn in is slightly less than this movement would represent. Once more the column of water returns under the elevated tank pressure and compresses the charge of gas and air, which is then ignited to start a fresh cycle of operations.

Ignition is timed by a small apparatus resembling an ordinary engine indicator, which closes the electric ignition circuit at the point of maximum compression, and an ordinary small battery, trembler coil and sparking plug, as used in motor-car work, are employed.

It should be noticed that the only moving parts, namely, the valves, open and shut under slight changes in pressure, and are all on their seats when explosion occurs; consequently there is no shock, and the pump works quietly and smoothly.

In starting the pump for the first time, compressed air is allowed to flow into the combustion chamber until the volume of air introduced is rather larger than the usual charge. The exhaust valve is then suddenly opened by means of a hand lever, and the escape of the compressed air permits a movement of the water column, which gives the cushion and suction strokes, and so draws in a fresh combustible charge, which, on ignition, starts the pump working regularly. If the pump is stopped when in regular work, it always stops with a fresh charge of gas and air in the combustion chamber, and then the restarting of the pump is simply effected by switching on the ignition current. The pump can therefore be started and stopped from a switchboard.

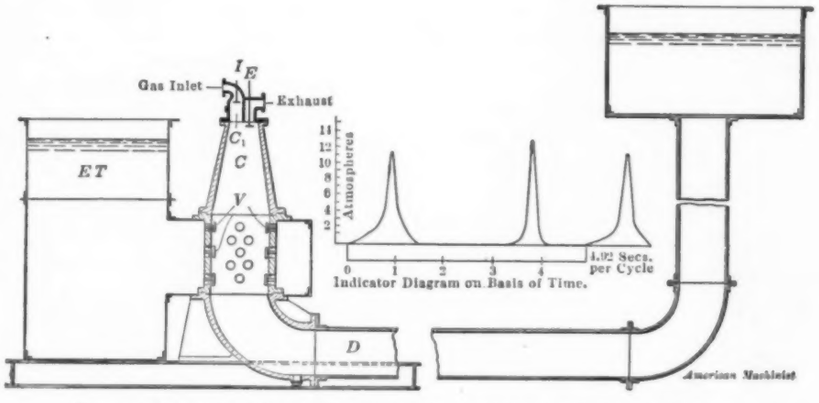


FIG. 1. SIMPLEST FORM OF HUMPHREY INTERNAL-COMBUSTION PUMP

ECONOMY TESTS

An additional pump, in operation for test while I was there, had a straight cylinder of 25 inches diameter, four feet in length, as shown in Fig. 2. This cylinder was set up in a small house and connected with the stand pipe shown in Fig. 3. A pipe, seen connected to the side of the stand-pipe, returned the water to the elevated measuring tank provided with

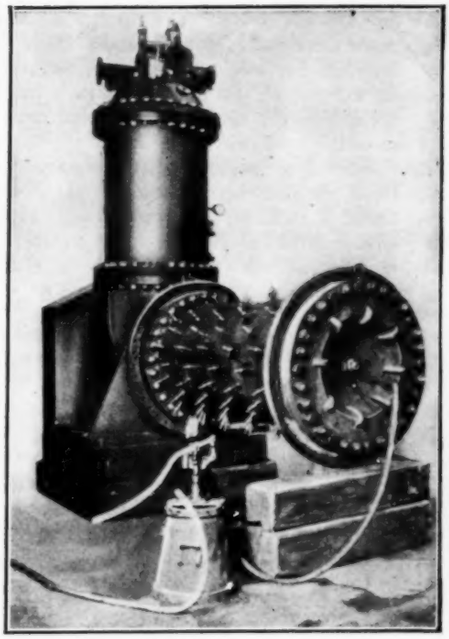


FIG. 2. GAS CYLINDER OF HUMPHREY PUMP, SHOWING WATER-INLET VALVES

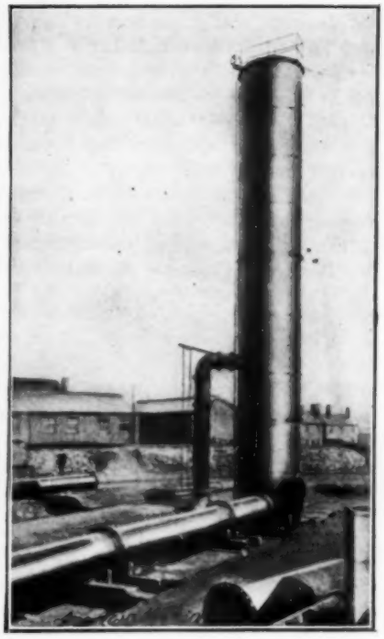


FIG. 3. STANDPIPE END OF TEST APPARATUS

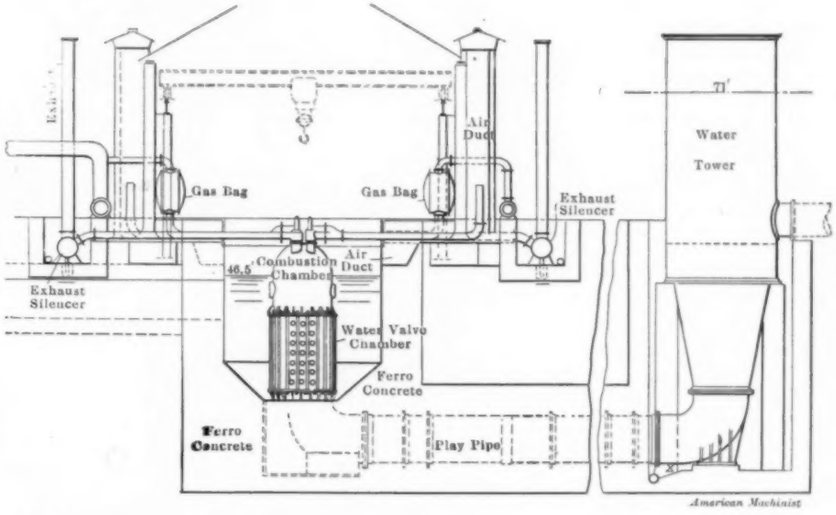


FIG. 4. ONE OF FIVE HUMPHREY PUMPS FOR METROPOLITAN WATER BOARD OF LONDON. CAPACITY 40,000,000 GALLONS PER 24 HOURS

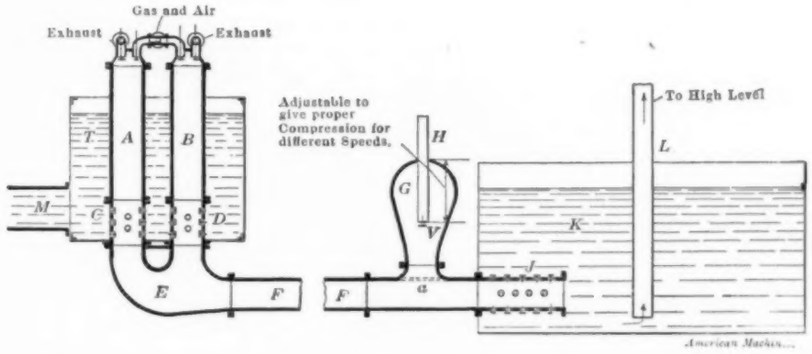


FIG. 5. TWO-CYCLE, TWO-BARREL HUMPHREY PUMP WITH INTENSIFIER FOR HIGH PRESSURE

baffles, gages, and an orifice in the bottom through which the water was delivered back again to the suction tank. A calibrated gas-holder, about 8 feet in diameter, measured the gas used by the pump. The plant was provided with a complete system of mercury and glass gages, making the performance of a test an easy matter.

The results of two tests made with the help of Mr. Smidt, manager of the French Westinghouse Company, showed a total thermal efficiency of 21.25 and 22.07 per cent. calculated from water horsepower to B.t.u.'s supplied. This was obtained with a 35 pump horsepower unit.

The smooth operation of this pump of a capacity of 4000 gallons per minute was remarkable. All the romance of the normal municipal pumping station was gone. No majestic flywheel and crank; no reciprocating parts, no glisten and glitter of polished surfaces; only the slight intermittent click of the exhaust valves and interlocking mechanism and the swish of the exhaust, which was without mufflers. The uncovered dome of the cylinder was only slightly warm, and I held my hand in the exhaust for ten seconds without discomfort. The water valves made no noise, and the explosions made only a dull thud. Control of the pump was by a simple electric-light wall switch. I started and stopped it with this switch several times, and after the second cycle it regained its normal speed of 12.5 cycles per minute.

Fig. 4 shows one of the five pumps designed for the Metropolitan Water Board of London, to be erected at Chingford. It will have a capacity of 40,000,000 British gallons per 24 hours. The lift is 25 feet, adapted to the simple type. This will be much increased if the two-cycle type is adopted, and the cost of the large plant not more than one-half that of centrifugal pumps and steam engines.

One admires the ability which enabled Mr. Humphrey to develop the simple form of pump from the rather complicated beginning. Among the first patents covering the explosion of a combustible charge directly upon a mass of water to obtain power, is that of P. B. Martin, of Paris, which was taken out 52 years ago. Many inventors have since, with different forms of pumps, used the above principle without practical results, but it remained for Mr. Humphrey to first use the kinetic energy of an unobstructed moving water piston to expand the exploded charge below the suction pressure, and thus entrain a fresh volume of liquid, exhaust the spent gases, draw in a fresh charge and compress ready for a new cycle, all by the oscillation of the liquid pendulum. The 4 strokes are unequal, as theory would indicate, and the expansion of the exploded charge of gas to atmospheric pressure, or into the partial vacuum of a high suction, give an efficiency considerably higher than the Otto cycle. The

energy is delivered directly to the work to be performed, eliminating flywheel, piston rod, cranks, bearings or glands, with their accompanying friction, lubrication and attendance. All valves are automatic, and ignition is controlled and accomplished by the compression of the charge, and internal cooling and low temperature of the expanded gas, make cylinders of any size or material possible, and as no fittings are necessary, except for pipe joints, the diagram, the pump and its operation may be described as follows:

First, dealing with the pump only, *A* and *B* are the two combustion chambers, *C* and *D* the two water-valve boxes, *E* the connecting chamber, and *F* the discharge pipe. In the top of *A* and *B* are fitted the usual admission and exhaust valves, but in this case the exhaust valve is set near the top of the chamber, as practically no cushion is wanted. The exhaust valve. The energy of the moving column is now expended in compressing the new combustible charge in *B;* whereupon, ignition in *B* starts a fresh cycle with the functions of *A* and *B* reversed.

Coming to the intensifier, we have the small air chamber *G* and the larger air vessel *K*. The pipe *F* terminates inside *K* with a valve box *J*. The small air vessel *G* is fitted with an adjustable pipe *H*,

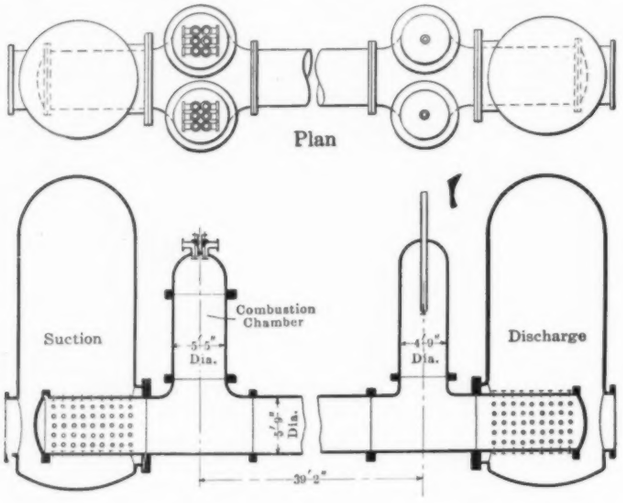


FIG. 6. 1400-HORSEPOWER HUMPHREY PUMP FOR 1,400,000 GALLONS PER HOUR, 200-FOOT HEAD

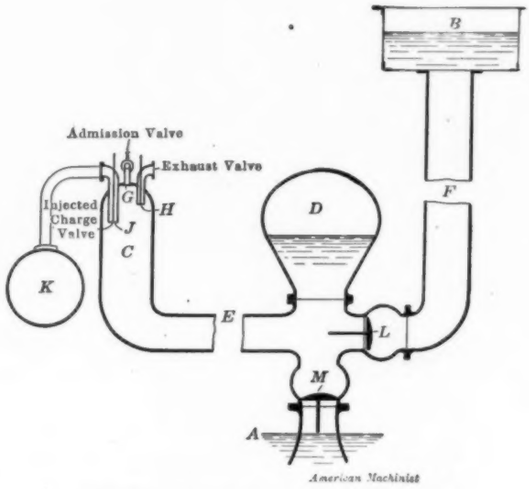


FIG. 7. PUMP FOR COMBINED HIGH SUCTION AND HIGH HEAD

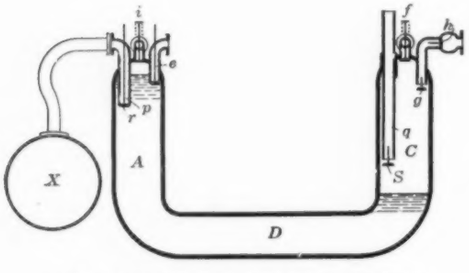


FIG. 8. HUMPHREY AIR COMPRESSOR

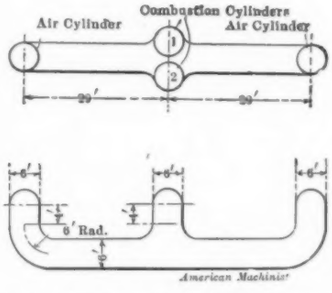


FIG. 9. TWO-CYCLE AIR COMPRESSOR

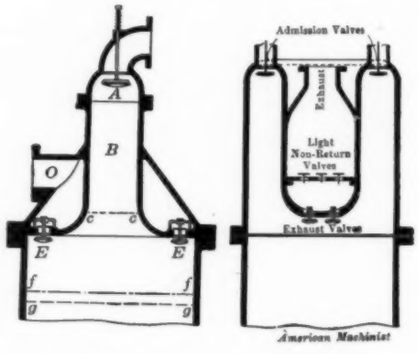


FIG. 10. FIG. 11. COMBUSTION CHAMBERS OF TWO-CYCLE PUMP

riveted construction and rough castings reduce costs.

With such high thermal efficiency the indirect method of generating power becomes attractive, and cost of operation is low, because of simplicity and certainty of control from a distance.

TWO-CYCLE PUMPS

The simple, low-lift forms of pump above described were naturally developed first, and their slow movement and large size impress the water-works engineer as indicating great weight and high cost; later improvements change this, and in Fig. 5 we have a double-cylinder pump, which draws in water twice each cycle and, by means of the air chamber before a set of delivery valves, called the "intensifier," will deliver water against a head which is independent of the mean pressure of the explosion. Referring to pump works with a drowned suction, being placed inside the tank *T*, the water supply being through *M*. Starting with a compressed combustible charge in the top of chamber *A*, and with *B* full of water, explosion occurs and drives the water in *A* downward and outward, setting the whole column of water in *F* in motion. When the gases in *A* have expanded nearly to atmospheric pressure, the water column in *B* is no longer supported and, falling by its own weight, draws in a fresh combustible charge which is throttled to prevent the charge being too large. The inlet water coming in through the valves follows the outwardly moving column and also rises in chamber *A*, to expel burnt products up to the level of the water in tank *T*. The column in the discharge pipe having come to rest, now begins to return and, rising in chamber *A*, expels the burnt products and closes open to the atmosphere and closed at the bottom by a valve which opens under its own weight and closes under the action of the impact of water upon it. Now, when explosion occurred in chamber *A* the water level in the small air vessel was, say, *a*, and while rising from *a* to *V* the energy of expansion in *A* is wholly used in giving kinetic energy to the water column. As the water strikes valve *V* it shuts this valve and then compresses the air in *G* until its pressure equals that in the high-pressure air vessel *K*. The valves in *J* now open and the energy in the water column is expended in driving water through these valves into *K*. When the water column stops moving, the valves in *J* close and the energy of the

compressed air in *G* drives back the water column, exhausts the burnt products from *A*, and compresses the fresh combustible charge in *B*. Thus everything is ready for the next cycle.

It will be seen that, by raising the pipe *H* the quantity of air compressed in *G* is lessened, and by lowering *H* it is increased. Thus, one has complete control over the amount of energy which is stored in *G* and subsequently utilized for compression of fresh charge. This enables one to operate with any compression pressure which may be desired. It also enables the compression pressure to be maintained constant in *A* and *B*, no matter what may be the pressure of delivery of the water from *K* through the constant-delivery pipe *L*. Thus, if the head is raised, pipe *H* can be raised, and this is the only alteration which is required to adjust the pump for different heads.

Fig. 6 shows a sketch, with approximate sizes, of a 1400 water-horsepower pump, now being designed in Germany,

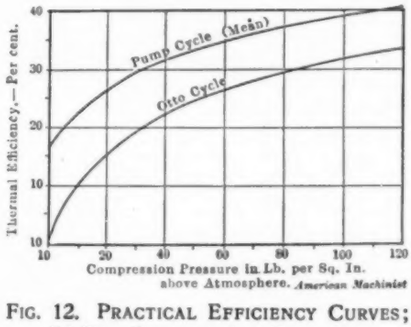


FIG. 12. PRACTICAL EFFICIENCY CURVES; 71 PER CENT. OF AIR STANDARD

intended to raise 1,400,000 gallons of water per hour to a hight of 200 feet. It operates as described above, with the addition of a precompression device, part of the pump itself, which sends a compressed charge to the combustion cylinders. This pump is expected to have 34 per cent. thermal efficiency and is to be used with a water turbine and generator to give 900 kilowatts of electrical current. With these auxiliaries it will take up much less room than a modern gas engine and generator of equal power.

Recent experiments have proved that at the end of the expansion stroke of a Humphrey pump the gases are so cool that it is quite safe to draw in a fresh combustible charge in contact with them, enabling Mr. Humphrey to design a pump of great interest and of phenomenal simplicity. Fig. 10 shows only the top of the pump, and the action depends upon the fact that the suction which occurs at the end of the expansion stroke may be used to draw in a combustible mixture, and that the burnt gases are cool enough not to cause preignition.

The combustion chamber has to be specially shaped so that the incoming charge, which may be preceded by pure air, displaces the burnt products and mixes as little as possible with them. Thus, in the drawing, *A* is the admission valve at the top of a tall but narrow part of the chamber *B*, in which the full charge volume extends down to the level *c c*. A number of exhaust valves, *E*, lead to a common exhaust outlet *O*, which may be fitted with a nonreturn valve, or each exhaust valve may carry a light nonreturn valve on its spindle, as shown. The level at which expansion reaches atmospheric pressure is, say, *f f*; but this level having been reached by the water, its further movement draws in fresh combustible mixture until it occupies the space down to *c c*, and the liquid level has fallen to *g g*. The column of liquid now returns and drives the exhaust products through the valves *E* (which opened by their own weight), until these valves are shut by the water. The kinetic energy acquired by the column is now spent in compressing the fresh charge, which is ignited to start a new cycle. Thus, each outstroke is a working stroke and no locking gear is required on the valves.

The same cycle applies to Fig. 11, but in this case there are a number of admission valves placed in a ring so as to allow the mixture to enter with a low velocity in order to prevent eddies and mixing with the exhaust products.

HIGH HEAD AND SUCTION

Fig. 7 shows a diagram of another curious form of pump. It will be noticed that the suction is at the same end as the intensifier, and is intended for combined high head and suction.

The operation is described as follows:

Outstroke = outward from pump.

Instroke = toward pump.

In describing the cycle (a) refers to what occurs at the pump, and (b) to what occurs at air vessel.

Water has to be lifted from *A* to *B*.

1st Outstroke (caused by explosion in *C*).

(a) Explosion in *C* followed by expansion to atmospheric pressure, then continued movement taking in scavenging air till column comes to rest.

(b) Compression of air in *D* until delivery pressure is reached, then water is delivered through valve *L* until column comes to rest.

1st Instroke (caused by expansion in *D*).

(a) Exhaust until valve *H* is shut by the water, then compression of cushion, which remains.

(b) Expansion of air in *D*, giving velocity to water column. When partial vacuum, equal to the suction lift is attained, water is sucked up past valve *M* to follow moving water.

2d Outstroke (caused by expansion of cushion in *C*).

(a) Expansion of cushion in *C* and intake of combustible mixture in excess, the first portion being taken from *K* through valve *J*, and the remainder through admission valve *G*.

(b) Compression of air in *D*, but no delivery of water.

2d Instroke (caused by expansion in *D*).

(a) Rejection of surplus charge past valve *J* until water shuts this valve. Compression of charge which remains.

(b) Expansion of air in *D*.

For clearness, the usual scavenging valve on pump is not shown. Exhaust and scavenging valves are released (or locked shut) together. Admission- and rejected-charge valves are released (or locked shut) together. Immediately beyond valve *L* an air vessel should be fitted so that the discharge in pipe *F* may be continuous and admit of quick discharge through *L*.

AIR COMPRESSORS

Air compressors, as described by Mr. Humphrey, are as follows:

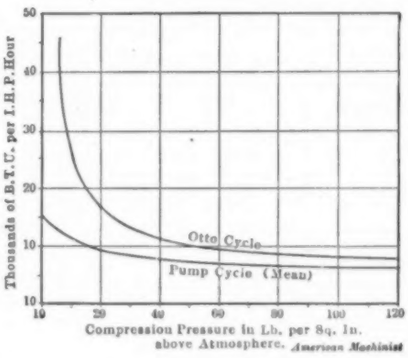


FIG. 13. B.T.U. PER INDICATED HORSE-POWER-HOUR. CALCULATED FROM 71 PER CENT. OF AIR STANDARD

If the column of water oscillating in the play pipe of a Humphrey pump is used as a water piston and caused to rise and fall in an air vessel fitted with suitable valves for the inlet and outlet of air, the combination constitutes an air compressor of a very efficient type promising many advantages.

Let us take the case of a single-barrel pump and a single air vessel, as illustrated in Fig. 8. *A* is the ordinary pump chamber and *C* the air-compressor chamber, and we may call them for convenience the "pump" and the "compressor," respectively.

The inlet valve *i*, for gas and air, and the exhaust valve *e*, for burnt products, exist as before, but the exhaust pipe and valve are adjustable vertically so as to vary the cushion space in the top of *A*. There is another pipe *p*, fitted with a valve *r*, and also adjustable vertically. A reservoir *X*, such as an old boiler shell, is connected by a flexible pipe to *p*. Corresponding parts are fitted to the compressor; thus, *f* is an air inlet valve; *g*

an outlet valve for air, which is shut by the water; and *h* a nonreturn valve for the compressed air. The dip pipe *q*, with its valve *S*, gives communication between the atmosphere and the compressor. The outlet pipe and the dip pipe are vertically adjustable, as in the pump. Lastly, suppose the play pipe *D*, filled with water; then we have all the elements required for working under the most varied conditions.

The cycle can be explained by assuming the water level is well up in *A* and low in *C*, as shown in the figure, and that a compressed charge is ignited in *A*. Expansion occurs, driving down the water in *A* and up in *C*. At first, air escapes from *C* through valve *S*, but when the water reaches this valve it is shut and the remaining air is trapped and suffers compression until the pressure of discharge is reached, when *h* opens and compressed air is delivered.

Next, the water reaches valve *g* and shuts it so that no more air can escape, and the water column is brought to rest by the continued compression of the remaining air which forms a cushion. Meanwhile, in chamber *A*, expansion to atmosphere allows the exhaust valve *e* to open, and the continued stroke draws in scavenging air (the scavenging valve being omitted from the figure for the sake of simplicity), but valves *i* and *r* remain locked. Now the column begins to return, due to the expansion of the compressed cushion in *C*, and this causes exhaust and cushion in *A* and, at the same time, there is first a fall of pressure in *C* to atmosphere, then valve *f* is opened against a light spring, allowing a fresh supply of air to enter.

So far we have had one outward and one return stroke, but the expansion of the cushion in *A* starts a second outstroke, which results in drawing in a new combustible charge in *A* through valves *i* and *r*, which were released on the shutting of the exhaust valve *e*. As the second outstroke is nearly as long as the first, it follows that too much combustible mixture is drawn in, but the surplus is got rid of on the second return stroke by allowing it to escape into the receiver *X*, and to slightly raise the pressure therein. Valve *i* was shut by its spring, but *r* waits to be shut by the action of the water, and when this occurs chamber *A* contains a definite volume of combustible mixture, the size of charge being fixed by the hight of *r*. Finally, we have only to observe that the second outstroke toward *C* merely compressed the air in *C*, without causing delivery to take place, but storing in the air the energy given out by the expansion of the cushion in *A*. The air in *C*, now expanding, gives the compression stroke in *A* and the combustible charge is ready to be ignited to start the next cycle.

Flexibility of the Compressor

It will readily be appreciated that by adjusting the level of the inlet valve *e* and the rejected-charge valve *r*, which are so constructed as to make this possible, and similar adjustments on the compressor side, the machine may be suited to variable pressure and air quantity, as may be desired.

It is also practicable to cause the variation in pressure in *X* to automatically adjust the quantity of water which reciprocates between the chambers to suit the capacity per working cycle, as theory would dictate.

Fig. 9 shows a double-cylinder compressor of the blowing-engine type. Two of these are capable of dealing with 25,000 cubic feet of free air per minute and compressing it to 25 pounds per square inch; a total of over 1600 horsepower. It is composed of two units as shown in elevation and plan, and the dimensions are given. As the pressure of delivery increases, the forces acting upon the water also increase and the accelerations become greater. Consequently, for a higher pressure of delivery the size of the apparatus becomes smaller for a given output.

Owing to the necessary presence of water in the air compressing cylinder, cooling of the air by means of partly submerged girds or screens is possible, so as to very nearly approach isothermal compression.

Using blast-furnace gas, dry-cleaned, a great economy may be made in gas, which may be converted into power, by driving rolls direct by means of Pelton water wheels; or engines with air; or, with combined pump and generator, electric current may be made for sale.

Efficiency Curves

Fig. 12 shows the practical efficiency curves of both Humphrey and Otto cycles at 0.71 per cent. air standard; Fig. 13, the B.t.u.'s per horsepower, calculated from 0.71 per cent. air standard.

These curves are taken from Mr. Humphrey's paper to show the effect of high pressure of compression on efficiency.

As more experience has been gained, the length of the water pendulum has been shortened and the speed quickened, until pumps of 1000 horsepower are expected to run above 50 cycles per minute. This change is all in the direction of increased efficiency. If the two-cycle pump proves satisfactory the efficiency and capacity of the same pump will be still further increased.

We have seen enough different forms of pumps in the foregoing to realize that they must have an extended field in the United States. The whole West needs a cheap economical pumping plant for irrigation purposes, either by pumping water direct from streams, or from wells by compressed air; mining regions need pumps for mine drainage, compression of air for drills, and driving the mine hoists in place of steam; pumping of sewage and drainage of low lands; all kinds of water works pumps; driving of reversible rolls in steel mills, and numerous applications of power around blast furnaces; as auxiliary plant to increase capacity of water powers, by pumping water back above the dam to utilize plant that would be idle in dry or very cold weather.

Comparative Efficiency and Weights of Steam and Gas Engines, and Pumps

The following table gives comparisons of efficiency and weights of steam and gas engines and pumps, the thermal efficiency being on the basis of coal under boilers and in producers.

Steam Engine and Pump.	Thermal Efficiency.	B.t.u. per Water Horsepower hour.	Weight per Horsepower, Pounds.
High-duty triple expansion.....	15.5	16,460	....
High duty compound, 550 horsepower, 322 tons.....	13.8	18,500	1170
Gas engine, direct pump attached, 300 tons, 395 horsepower.....	19.0	13,444	1520
Humphrey Gas Pump. 200-foot high lift, 130 tons = 1000 horsepower.....	25.7	9,900	260
25-foot low lift, 90 tons = 205 horsepower.....	19.5	13,000	878

Prices are difficult to compare with the English prices, but as the Humphrey pump will always cost less, per pound, it must be comparatively very cheap to build.

The cost of gas-engine pumps in England is £35, per gross ton, or 7.8 cents per pound, or $118 per horsepower.

The cost of high-duty compound steam engines, in the United States, is 10 cents per pound, or $120 per horsepower.

$$\frac{\textit{Weight of Humphrey high-lift}}{\textit{Weight of high duty compound}} = \frac{1}{4.5}.$$

$$\frac{\textit{Weight of Humphrey low-lift}}{\textit{Weight of high duty compound}} = \frac{1}{1.33}.$$

The type of pump which has been seen in operation has a drowned suction, and if no other kind could be used it would impose a limitation in situations where variable suction lift is needed, and it would be inconvenient to construct a pit for the pump cylinder below low-water level. The use of high suctions has been worked out, and it remains to demonstrate it on a large scale. There is no reason why a suction air chamber will not make an artificial horizon of the water at proper level.

According to recent report of the United States Geological Survey the production of graphite artificially by electricity at Niagara Falls, N. Y., in 1908, was 7,385,511 pounds, valued at $502,667, against 6,590,000 pounds the preceding year.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room. A letter good enough to print will be paid for. The value is in the idea—not the length of the letter

Management versus System

So much is being said of different plants having thrown out this or that particular system—and much of it is based on truth—that "systematizing" is being looked upon by many with suspicion and distrust. It may therefore be profitable to look into the matter with a view to determining some of the causes of the reaction.

I recently enjoyed the privilege of going over a beautifully equipped plant engaged in the manufacture of a limited number of lines of wood-working machinery. There was a hunted look in the eyes of the shop superintendent when I asked him what system he employed in the routing and costing of his work, and the payment of his men. He stated that a prominent firm of systematizers had completed, a few months before, their work of systematizing the plant, extending over a period of about 15 months; and that it had been necessary to throw out every vestige of their work in order to get the plant on a practical, paying basis.

What was the reason for the failure of this system under conditions practically ideal for the efficiency engineer? Simply this—and it is the key to a majority of these troubles—system of *operation* had been mistaken for system of *management*.

No system is self-perpetuating; no system will of itself run a shop smoothly and efficiently. The system is only the tool of the manager, his appliance for running the plant it is almost a living thing, not a mere observance of rules and filling out of cards and forms.

The shop superintendent said that his foremen "were running around with pencils stuck over their ears," that "they didn't have time to attend to their jobs." The aim is to improve efficiency; that is, to bring equipment, arrangement and environment to their best possible condition, and then to eliminate waste motion. If this last is accomplished, then any change of method, on the part of any member of the force, results in more work for him for a given production, provided that compensation is based on individual production. It is plain that the supervisory force must do work, and why not, then give them tools wherewith to do it? The tools may be mechanical appliances, or certain cards or forms; but if the job is given them, and then the tool, they will find that the job must be done to keep the rest of the plant running and that with the tools they can do it best. This is a condition contrary to that described by this shop superintendent, yet it is a part of scientific management.

This discarded system was top-heavy because it was not functional; foremen were given clerical duties and their real work obscured and interfered with. In short, the systematizer was not conversant with real shop conditions and necessities.

Efficiency engineers are divided into two classes; those who are men of shop experience, and introduce methods of management; and those who are accountants and theorists, and introduce systems of operation. The former eliminate waste, functionalize work, and provide real costs for the manager's use; the latter distribute duties, and provide for record figures showing what costs ought to be. Enduring, beneficial results can only be assured by the former class.

But certain results are prerequisite, even if real engineers of practical experience are retained for betterment work. Since the system is to be the tool of the manager, he must understand, and be in sympathy with, the principles underlying the methods to be introduced. There are at least two different schools of management now recognized, founded on radically different principles; one may be better than the other, both have their warm adherents and exponents; but certainly great improvements can be, and are being, effected by the application of each. Abiding belief in the one to be adopted, however, is absolutely necessary to its success.

Another condition is the necessity for the recognition of the value of the system as a tool only, and for actively, continuously, employing it; not leaving it to run things of itself.

Systems are actually being discarded, and discredit is thus being shadowed over some of the good work that has been done. But these three considerations explain the trouble in large part, and when more generally understood, the betterment work will meet with less opposition.

FREDERIC G. COBURN,
Assistant Naval Constructor, U. S. Navy.

Can Forgings be Graded by the Grain?

Perhaps the readers of the AMERICAN MACHINIST can help us out in a question that has come up lately.

In the regular course of business a number of broken engine crank shafts have been returned to us from customers who have claimed that the material in them was defective. These cranks were steel forgings that were made without welds; each crank being forged from a billet of the proper size. The breaks have all been of the progressive kind, and the immediate cause has been that the bearings have not been cared for in such a way as would keep the crank in proper alinement.

While this is true, it is also true that the grain of the forging, as shown at the point where the final part of the break took place, shows a decided difference in the different cranks. This difference can be recognized with the naked eye, although it is much more apparent when specimens are prepared and examined under the microscope.

Ignoring the question as to how the customer uses the crank it seems reasonable to state that he should receive a good crank to start with. So, also, the engine builder is entitled to receive a good crank from the forge works.

Practical men who know that a range has to be allowed for commercial work that is quite a distance from the best possible work. They like to see a fine grain in a forging, and do not like to see a coarse one. Their experience teaches them that a fine grain indicates toughness and that a coarse grain indicates the opposite.

The metallographists say that the coarse grain comes from high heat and that it is found in material that has been poor in service, while material that has been noted for good service shows the fine grain.

Up to this point we seem to agree. In talking with the superintendent of one of the large forge works a short time ago, our ideas on this seemed to agree. It was when we got to talking of some way of establishing limits that we seemed to get beyond our depths. He was confident that he was perfectly

able to tell, by looking at a fresh fracture, whether a broken crank had been properly forged or not, but he did not seem to be able to tell me so that I could know. He recognized that there was a range of heat beyond which it was not advisable to finish a crank forging, it must not be too high nor too low, but he could not give me a temperature on the high end. He knew it when he saw it, having learned it from experience, but could not give it in figures. It should not be below the critical point.

It would seem that the makers of forgings, the users of forgings, and the scientific men agree that a fine grain is desirable and a coarse one undesirable. Therefore, the practical point that I would like to have the readers help out on is:

How fine should a grain be to be good enough to use, or how coarse should it be to justify refusing to use it?

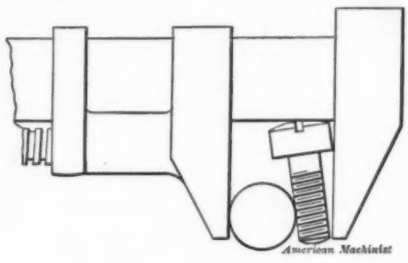
It stands to reason that if a very coarse grain shows a worthless condition, as it does, then somewhere along the line toward the best grain comes one that is as good as can reasonably be expected. If such a point is recognized as being there and being sought for, by and by it will be known as well as the critical point now is.

My presentation of this matter may not be as clear as it should be, but I believe that the subject is one that is of great importance and that it is one that should receive serious attention.

Meadville, Penn. W. OSBORNE.

An Emergency Pipe Wrench

How frequent is our need of a pipe wrench when one is not to be had? The substitute described herewith has helped out in many such a case. Perhaps the idea is old but nevertheless a good thing bears repetition. The kink is to place a hard short-head screw in the jaws of a monkey wrench as shown in the sketch.



AN EMERGENCY PIPE WRENCH

The threads of the screw bite into the pipe with as good a result as if a pipe wrench were used.

Cincinnati, O. R. A. RUDOLPH.

Bevel Grinding Attachment for Planer

Accompanying is a sketch of an angle grinding fixture, used in connection with an ordinary planer, being mounted on the cross rail thereof.

This fixture was designed to grind the bevel on long lengths of stock of cross-section as shown in drawing, and consists of a base *A*, upon which is mounted the bed plate *B*. This in turn carries the slide *C*, which accommodates the shaft *D* and the emery wheel *E*. The base *A* is provided with slotted ears *a a*, by means of which it is bolted to cross-rail carriage of planer.

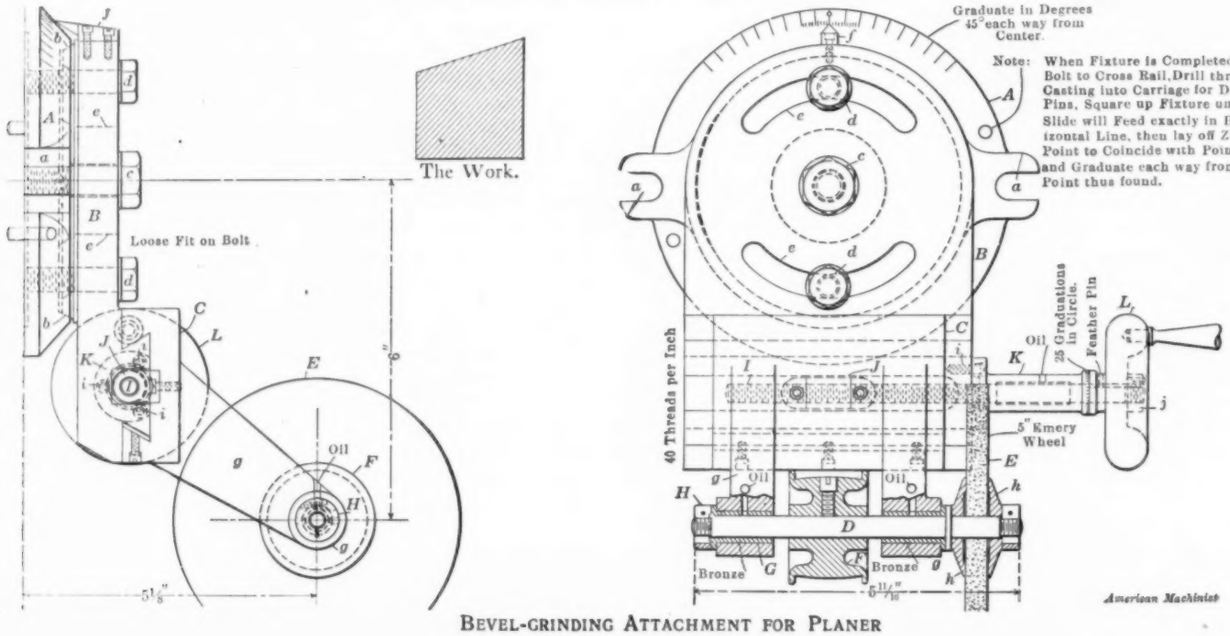
Bed plate *B* is seated and turns in base *A* upon the conical seat *b b*, and is held in place by the bolt *c* which fits loosely in casting *B*. The bolts *d d* work through the slots *e e* and when loosened allow the bed plate to be turned either way from center, up to 45 degrees, and clamped in place at any angle as indicated by the pointer *f*. The projecting arms *g g*, of the slide *C*, carry the shaft *D* on which is mounted the pulley *F* and emery wheel *E*, as shown. Shaft *D* runs in bronze bushings *G G*, and is adjusted for end-shake by means of the spring checknut *H*. A similar checknut is used on the opposit end of shaft, to tighten the clamping members *h h* upon the wheel *E*.

Transverse movement of the slide *C* is effected by means of the screw *I* working in the nut *J*, which is screwed to the slide. The housing *K* is screwed to the bed plate *B* by the screws *i i*, and serves the double purpose of a support for end of screw and preventing lateral motion of the latter. Screw *I* is turned by the handwheel *L*, keyed by the feather pin, as shown, and held in place by check nut *j*. End of housing *K* is graduated to 25ths, in the full circle, which, with the 40 pitch screw *I*, gives a feed of 1/1000 inch for each graduation.

In operation, the bar to be ground is clamped upon the planer table and fixture is mounted upon cross rail. For grinding stock that is square in cross-section, the pointer is set at zero and either the cross feed of planer or that of fixture may be used; but when grinding down a bevel at any certain angle the feed on the fixture alone is, of course, used.

Kankakee, Ill. F. W. B.

The recent developments in drilling machines may make it advisable to change their names to "rotary punches."


The Work.
Loose Fit on Bolt
Oil
5 1/8"
Graduate in Degrees 45° each way from Center.
Note: When Fixture is Completed, Bolt to Cross Rail, Drill through Casting into Carriage for Dowel Pins. Square up Fixture until Slide will Feed exactly in Horizontal Line, then lay off Zero Point to Coincide with Pointer and Graduate each way from Point thus found.
40 Threads per Inch
25 Graduations in Circle.
Feather Pin
5" Emery Wheel
Bronze
5 11/16"
American Machinist

BEVEL-GRINDING ATTACHMENT FOR PLANER

Discussion of Previous Question

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers

Design of Ball Thrust Bearings

In further considering the matter of unequal loading in ball-thrust bearings, Gustaf Rennerfelt, on page 884, Volume 33, Part 2, while admitting that clearance between ball plate and shaft is necessary, reiterates some statements made in several of his previous writings, the discussion of which will be profitable.

Mr. Rennerfelt states that the load cannot equalize, owing to the frictional resistance of the spherical plate to shifting in its seat, and then gives formulas for determining the difference in load on opposite balls. The trouble with his reasoning is that it is based upon an assumption instead of a condition, and one that, moreover, is wrong. The wrong assumption is that the load is constant and that the friction at the plate is constant, opposing compensating shifting of the plate.

But does this apply? Are the conditions of practice really those assumed? There are very few machines indeed that run so steadily that there is no vibration. Vibration means continual receding and approach of surface and, with that, a vibratory relief of the load and friction. It is as clear that deductions based upon a constant, nonvibrating load are misleading, as that this fundamental assumption fails to respond to the actual condition.

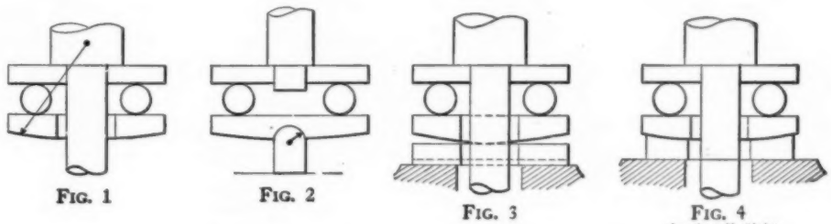


FIG. 1 FIG. 2 FIG. 3 FIG. 4

American Machinist

COMPENSATING PLATES OF BALL-THRUST BEARINGS

Mr. Rennerfelt shows an arrangement, Fig. 2 here, of which he says that it "tends toward parallelism;" that is, even load distribution. Really he means, tends toward that in *greater degree* than the spherical seat of Fig. 1. Fig. 2 has the fundamental defect for most situations that the shaft cannot pass through the supporting plate. Fig. 3 shows an arrangement that not only "tends toward" uniform load distribution, but absolutely insures that, and has the advantage of not limiting the shaft arrangement. The lower side of the ball plate is formed to a very obtuse-angled knife edge across its center line; this rests on a second plate that has a similar knife edge resting in its support on the housing; these two knife edges are arranged at right angles to each other and thus are the equivalent of a spherical seat, but substituting rocking for sliding. The same faulty reasoning that led Mr. Rennerfelt to his conclusion, led me to this knife-edge arrangement as a remedy. Trials showed that it possessed no advantages over the spherical seat of Fig. 1.

But these trials led to further investigation, which showed that neither this arrangement nor the spherical seat of Fig. 1, nor Mr. Rennerfelt's seat of Fig. 2, were sufficiently universal to compensate for the complex disturbing conditions arising in practice. So long as movements or deflections were of the character of rotations around a center lying in the shaft axis they would be compensated for by Figs. 1, 2 and 3. If the movement or deflection were a purely straight-line one, transversely across the shaft axis, no rocking around any center could possibly compensate. But the arrangement of Fig. 4, in which the seat for the spherical plate is itself free to move transversely, provides for all possible shiftings of shaft and support, and so allows of a uniform seating of the shaft plate on the complete ball circle, and of that on the lower plate.

Moreover, this arrangement allows the correct motion for relative alinement whether the balls roll on flat tracks or in grooved tracks on one or both races. This is important, since grooved ball tracks greatly increase carrying capacity (over five times, as between flat tracks and grooved tracks whose radius is two-thirds of the ball diameter). Successful practice in many thousands of cases has demonstrated that the compensating movements actually do take place, and probably because of the reason cited that vibratory change of load provides the opportunity. Probably, were the seats dry, the compensation would be less free; but as ball bearings must always have abundance of oil the seats never are dry.

Whether the theoretical reason to account for a condition be right or wrong, that does not affect the fact, which here is that a seat for thrust bearings so arranged as to allow for universal relative adjustment for any condition of initial inaccuracy or of subsequent deflection, does assure substantially uniform distribution of load over the complete ball circle, well within the safe carrying capacity of each individual ball.

Philadelphia, Penn. HENRY HESS.
President Hess-Bright Manufacturing Company.

Modern Grinding Practice

Mr. Darbyshire, Volume 33, Part 2, page 1126, is evidently after something quite different from what I am, and while he states I obtain the same results by more expensive means than he describes, I don't see where this comes in. When operating a precision grinding machine I always dress the wheel with a diamond, as I have found it impossible to obtain accuracy by using a pebble. Mr. Darbyshire says a blunt diamond is an abomination and has caused endless trouble, and immediately after this states that when a wheel is trued or dressed with a diamond in this condition, it is a polishing wheel only. This is just the point Mr. Darbyshire brought out at page 728, Volume 32, Part 2. He had to make a polishing wheel out of the cutting wheel to put a high polish on work.

Using a pebble to dress the wheel may have been more convenient than a diamond as it is impossible to dress the wheel on his machine at any other place but the footstock, while on a machine with a stationary work table the wheel can be dressed in any position of its travel.

A few days ago I was operating in a factory where they manufacture automobile engines in large quantities grinding piston pins on a 10x30-inch Landis, using a 60-wheel 14x2x5 inches, which was too fine and hard. I found it necessary to dress this wheel with a sharp diamond,

while if I had been using a coarse soft wheel on similar material, it would not have been necessary to use what is considered a sharp diamond.

Mr. Darbyshire criticizes the expression, "Cutting point of the diamond" and describes it as "Cutting edge," the former is commonly used. It is shop practice we were discussing, not geometry.

I will state that I do not advocate a dull diamond for dressing the wheel, except where a high gloss is required. Following is abstracted from *Grits and Grinds*. "Truing means to perfect the wheel, make a perfect cylinder of it, which is absolutely necessary if it is intended to grind a perfect cylinder with it."

J. H. HOLLINGER.

Waynesboro, Penn.

A New Speedomete

I notice on page 668 a description of the Forse speedometer. It is almost identical with one I made about 18 months ago. As I was very busy at the time I put it aside to be perfected later. I regarded it as a sort of nest egg, something to fall back upon in case anything happened as the saying goes. Something has happened, that's true, but where's my nest egg? The yolk has gone, and the white too, but the shell may be worth investigating.

The first model was made as follows: Two plates were made, and held together by means of tubes and rods, as shown in Figs. 1 and 2. I then made two sheet-steel brackets, to carry the governor shaft, and a small pair of governors out of sheet steel and punchings, the latter acted as weights, and were so arranged that they could be fixed in various positions on the governor arms. This idea served its purpose very well, as it enabled me to alter the power of the governors considerably. In the top of each governor arm, I fixed a small pin, and on the top of these rested a sleeve with slotted extending pieces. This sleeve was made to slide up and down the shaft actuated by the governor, and was in turn connected to the quadrant, and the quadrant meshed with a small pinion on the indicator shaft.

The effect of the governor on the indicator, when working, needs little or no explanation, but I may say that this combination, as above set out, was a total failure as far as reliability was concerned, and an indicator that is unreliable is valueless. I found out that the main trouble was caused by there being too much friction between the parts connecting the governor to the quadrant. So to overcome this, I made a *ball* governor, as shown in Fig. 3, which, by the way, is almost identical with that used by the Forse Manufacturing Company, in their new speedometer, to which I have previously referred. This ball governor showed great promise, and made a wonderful difference in the working of the indicator. When it was first made, I allowed the balls to run freely in the cup, but I got much better results by fixing a small pin in the latter, to compel the balls to rotate, as I found that if they were allowed to lag behind they lost a great deal of their efficiency. I then made various tests, by running the indicator at known speeds, and the results were very promising. At this stage, when the idea was beginning to shape, I was called upon to undertake and perfect other inventions of greater importance, and my indicator was shelved, and so decided the fate of my humble efforts.

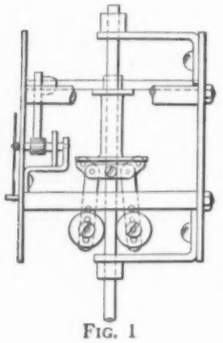
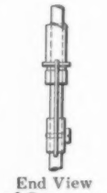


FIG. 1



End View of Governor.

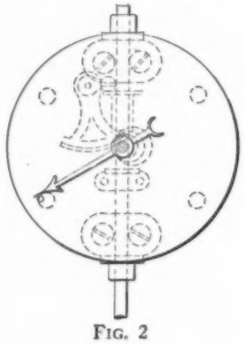


FIG. 2

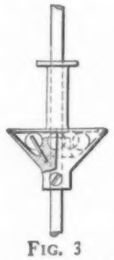


FIG. 3

American Machinist

THE TWO SPEEDOMETERS

England. W. S. JOPSON.

Direction of Motion of Gears

With reference to the kink by C. D. K. which appears under the above heading on page 738, I am of the opinion that the method I always employ is still simpler.

The method is to count the number of wheels in gear between the wheel whose direction is known and the wheel whose direction it is required to find, then, if the number of these wheels is odd the direction of motion of the unknown wheel is the same as that of the driver or known wheel. If even then its direction of motion is opposite to that of the driver or known wheel. That is to say, in Fig. 1 the direction of *A* being known, then *G* will rotate in an opposite direction to *A* because there are four (an even number) wheels in gear between them, while *H* will rotate in same direction as *A* because there are five (that is an odd number) wheels in gear between them.

Moreover C. D. K.'s method is not applicable to wheel trains as shown in Fig. 2 while the above method still applies, if we count the pinion and wheel which are keyed to the same shaft as one wheel.

Thus in Fig. 2 the rotation of *A* being known and it being required to find the rotation of *K; K* will rotate in same direction as *A* because the number of wheels in gear (counting pinion and wheel keyed to same shaft as one) is odd, namely, three.

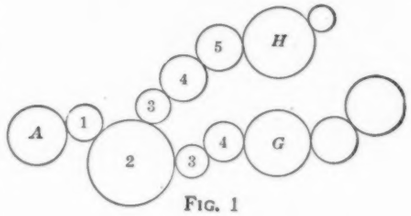


FIG. 1

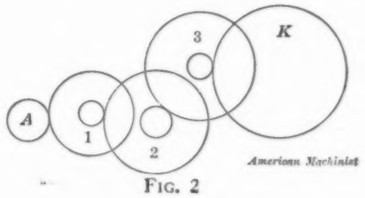


FIG. 2

DIAGRAMS OF GEAR TRAINS

Manchester, England. L. NIKCUL.

In the *Electrochemische Zeitschrift* is described a patented German process applied in welding dissimilar metals of high melting point, as Fe and Ce, Fe and Ag, Fe and Au, Fe and Al, Cu and Al, or combinations of such metals and alloys. The process is based upon the combining of metals of high melting temperature in such a way that they cannot be separated by mechanical means. The clean surface of the one metal is brought in contact with the molten mass of the other metal which has been superheated much above its melting temperature, whereby a combination of the metals is attained. It has been found that Cu, Ag, Au, Al bronzes and similar metals and alloys of a high melting point can be made very fluid if they are heated far above the melting temperature, in which state they possess peculiar chemical or physical properties, which make it possible to combine such metals with another metal when brought in contact with the same, whereas at a lower temperature this combination cannot be effected. During the process of combining the metals a film of the overheated metal is formed on the surface of the cold metal, a deposit which can be made in any desired thickness. In order to prevent oxidation the surface of the metal is inclosed in a cell connected to a pipe line for admitting a deoxidizing gas such as producer gas.

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American Machinist

Loyalty

There is no place where loyalty is of more importance from top to bottom than in a machine-shop force. Men are in demand who will obey orders, but that is not enough—there is need of men who will think for the firm and disobey orders at the right time. Every manufacturer has been cursed at some time with subordinates who always obey orders, but who go out in the shop and boast that they have an order which is a mistake, and then go ahead and carry out the order to the letter. Of course, no one can be discharged for obeying an order, but it would seem as if such men would realize that their dismissal must only be a matter of time.

Then there is the man whom we all know who does obey orders to the letter, but who accepts every order in a manner that seems to say: "Of course, I will do it that way, but its a fool way to do it," and then goes out in the shop and says the same thing to the man on the next lathe.

One way to handle such cases is to discharge them arbitrarily, but as a matter of kindness to the next employer it seems that something should be done in the way of reform. Kindness in the usual way seems to be wasted. Perhaps the most effective weapon is forbearance. In the natural course of human effort every man makes a bad break at varying intervals. A man who has made one of these senseless mistakes and is pardoned is under a degree of obligation to the one who excuses him that must, if there is a spark of gentlemanliness about him, rouse his latent sense of loyalty.

This brings us to another phase of the matter. Observance of such cases seems to place the larger part of them under the head of disappointed men. Men whose home life is a disappointment, men who have had better positions and lost them are peculiarly susceptible to this disease; men who think they ought to have been promoted, but have seen others pick their favorite plums, are almost sure to have it unless they are satisfied that they can do no better elsewhere.

Such men should, for their own good, change to another shop until they find one where they fit. There is a moral obligation due to an employer from every employee—to give his best mental effort as well as his manual labor. If a man finds himself where he cannot conscientiously carry out the plans of his employer, whether expressed directly or by inference, he should state his case and withdraw. On the other hand, an employer owes a degree of loyalty to his help. He is reprehensible if he does not stand by the consequences of a wrong order if it is carried out loyally. A man who is unfair is none the less to blame because he can build up a plausible excuse.

Unmasking the Treatment of Steel

We have watched the efforts being made in some quarters to throw an air of mystery around the heat and cooling treatment of steel and iron with feelings far stronger than mere disfavor. It is, therefore, a pleasure to call particular attention to Mr. Baker's article, printed in other columns of this issue, in which he deals with this subject in such a straightforward manner. Mr. Baker has had an unusually wide experience in forging and treating steel and writes with authority. He states in the plainest of language that there is no mystery whatever about the matter; that the cooling of iron and steel is as simple as the freezing of water; that all other things being equal, the more quickly steel is cooled the finer is its grain.

It is not surprising that this attempt has been made to befog the heat-treatment of steel. It is, in fact, a hereditary attitude, for the hardening and tempering of the past was looked upon almost as alchemy. Mysterious drugs and preparations were used; in fact almost incantations. Would that all this was entirely a thing of the past.

This heat and cooling treatment of steel is one of the most important processes, if not the most important, that has been developed in late years in connection with the working of materials of construction. Its benefits are enormous, its expense is slight, and it is here to stay. Yet the quotation given by Mr. Baker in his article, "Unless something radical is done, steel treatment will be severely discredited," is a disquieting statement, to say the least. But this can only be for a time as a matter so important cannot long be obscured. One way to avoid this temporary discrediting is to have everyone who comes in contact with this process in any manner distinctly understand that there is no mystery whatever surrounding the process. It is fundamentally based on a simple principle—slow cooling produces large crystals, and the opposite is true of rapid cooling.

Trade School Problems

The trade school has many problems and in many cases is a development of the manual-training school, where a few work benches and an inexpensive set of tools are all that are needed, so that the question of equipment becomes more of a problem than many have anticipated.

Instead of a few hundred dollars, as in the manual training and woodworking branches, it requires several thousand to give a fair equipment of lathes, planers, shapers, milling machines and drills, so that a fairly general knowledge of machine tools can be obtained.

Having the necessary equipment, the next problem is what to make and what to do with it. Nearly all agree that the making of things for self, or mutual admiration is not as efficient for training as the making of the real product.

Some advocate the making of machine parts for local manufacturers and this has many advantages where it can be satisfactorily arranged. It gives the boys practical work that must be made commercially accurate and with an approach to commercial time.

Others believe that it is better to build a line of small machines or appliances and ... s has the advantage of being more controllable as to the way the work may be done, than in the other case.

But the making of patterns, the getting of castings and the preliminary work necessary to the launching of even a small line, is quite sure to take more time and money than directors, who are seldom familiar with the work of producing a line of tools ready for the market, are willing to consider.

And then the marketing of the products—a very different and more difficult matter, as it involves a selling plan and a sales department if the products are really to be sold. This means advertising, salesmen or agents, or all these and more.

While some manufacturers object to such products being sold, the volume of business is too small to cut much figure as a competitor. And, when the trade school is a State or city institution, as is often the case, anything that tends to reduce the total cost of operation, comes back to all who contribute to its support, by taxes and otherwise.

New Publications

"Machine Shop Primer," by Fred H. Colvin and Frank A. Stanley. 148 6x9-inch pages with 508 illustrations. The McGraw-Hill Book Company, New York and London. Price, $1.

This book is exactly what its name indicates and is intended for beginners in machine shops and industrial schools. It is divided into three sections, the first consisting of numbered illustrations alone, while the second gives, against the same numbers, the names of the things illustrated. Section III is a more extended list of definitions and forms in effect a machine-shop dictionary. In it the things shown in Section I, together with many others not so shown, are defined, some of the illustrations of Section I, especially those showing complete machine tools, being repeated with the names of their principal parts.

There is no doubt of the value of such a dictionary to the new apprentice, who may find in it illustrations and correct names of the bewildering array of new things that confront him at the beginning of his shop career.

Personals*

Ethan Viall has resigned as Western editor of *Machinery*.

W. L. Webb and James M. Kennedy have become associated with the engineering firm of Dodge, Day & Zimmerman, Philadelphia, Penn.

Director Diehl, of the Benz Automobile Company, Mannheim, Germany, who has been staying in this country for the past four weeks, sailed for home on December 27.

F. P. Huston, sales manager of the Kempsmith Manufacturing Company, Milwaukee, Wis., recently left for an extended trip through Europe in the interests of the company.

Director Klein, of the Bosch Magneto Company, Stuttgart, Germany, is expected to arrive in this country in the near future to spend several weeks in the interests of his company.

Charles W. Beaver, of the hoisting department of the Yale & Towne Manufacturing Company, sailed on December 28 for a four months' stay in England in the interests of his company.

W. R. Lathrop has been placed in charge of the Birmingham sales office of the Niles-Bement-Pond Company and the Pratt & Whitney Company, replacing N. C. Walpole, recently resigned.

Malcolm Libby, actively engaged in engineering work and construction in California for a number of years, has become manager of the engine department of the Canadian Fairbanks Company, Toronto, Can.

Charles A. Francis has accepted the position of manufacturing superintendent of the National Printing Machinery Company, formerly of Kansas City, Mo., but which is to locate in Athol, Mass., in the near future. He desires catalogs of machine tools.

Edgar Lowenthal, of Lowenthal & Co., Buffalo, N. Y., representatives of Messrs. Vickers Sons & Maxim's Elco high-speed steel, has just returned from a six weeks' visit at the works in Sheffield. While abroad he also called at several of the other interests of the company, throughout England.

*Items for this column are solicited.

Rudolf Ernst Wolf

Rudolf Ernst Wolf, widely known manufacturer, of Madgeburg, Germany, died on November 20, having passed his seventy-ninth birthday.

Mr. Wolf began his industrial career in 1847 as an apprentice in a machine shop. For the succeeding eight years he gained experience in several shops and at the early age of 24 filled the position of chief engineer of an important organization. Six years later he decided to start a factory of his own and in 1862 established a machine and boiler shop at Buckau, Germany, and from the beginning specialized in portable steam engines, having radically new principles,

Rudolf Ernst Wolf

original with him, for which he was later to become internationally known. His design of engine contained removable tubular boilers with cylindrical fire boxes; the working cylinders were live-steam jacketed and connected with the steam dome itself. Thus he was the founder of modern German locomobile construction and developed the engine to its present important position. Among the radical improvements which he introduced were the method of compounding and the use of highly superheated steam.

Mr. Wolf was not only a superior engineer, but displayed exceptional executive ability, in connection with which a pleasing personality greatly influenced his selling organization. As an employer he won the highest esteem of his workmen, and in respect to pensions and various other means of social benefit among them, he far exceeded the requirements of the paternal German laws, and long anticipated them.

Shop Equipment News

ANY and all new or improved machines, tools or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here — the machine shop news.
A more full and detailed description will be given — when it is real news — if it can appear here first — before it is sent to other papers. ALL descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German

A New Turret and Turret Slide

In Fig. 1 is shown a new turret to be applied to the carriage of the engine lathes made by the John B. Morris Machine Tool Company, of Cincinnati, Ohio. This turret is made interchangeable with the compound rest and contains a bronze nut to engage the cross-feed screw of the carriage. A bracket is provided which can be bolted to the back of the carriage and this bracket has an adjustable stop screw to serve as a positive stop for the turret. The tool-steel locking pin is controlled by a lever *A*, and this pin engages a hardened tool-steel index ring. The wear of the locking pin is taken up by a tapered gib, adjusted by screw *B*. The hexagon turret is 9 inches across flats and 5 inches high and will permit of holes 2¼ inches in diameter.

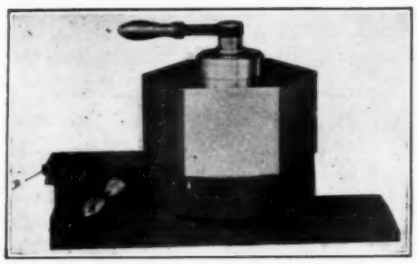


FIG. 1. THE NEW TURRET

Fig. 2 illustrates a new turret slide manufactured by the same company and is supplied with their various sizes of engine lathes. It is without power feed and the movement of the slide is accomplished by hand through the pilot shaft and pinion in the ordinary manner. The hexagon turret itself is revolved and locked automatically or by hand, as desired. Provision is made for disengaging the devices for automatically revolving the turret when it is desired to operate it by hand. This turret slide is also supplied with power feed and automatic stop and when arranged in this way a gear box is mounted on pad *A*. This gear box contains a train of gears, the driven one of which is keyed to the pilot shaft, and the driving gear is splined to the lead screw. This gives as many rates of feed as there are changes for feeding or screw cutting. The automatic stop is always supplied with the power feed and in such cases the top slide is provided with a tee slot at *B*, which receives the adjustable stop dog. The stop dog operates a latch which disconnects the gear-feed train previously referred to. The turret shown is for 16-inch lathe and has 9-inch traverse when revolved automatically and 12-inch traverse when operated by hand. The hexagon is 9 inches across flats and 5 inches high. It will clear tools whose diameters are not to exceed 5½ inches.

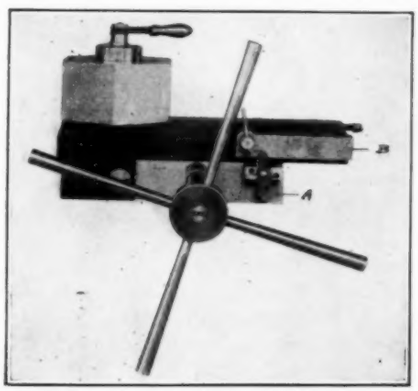
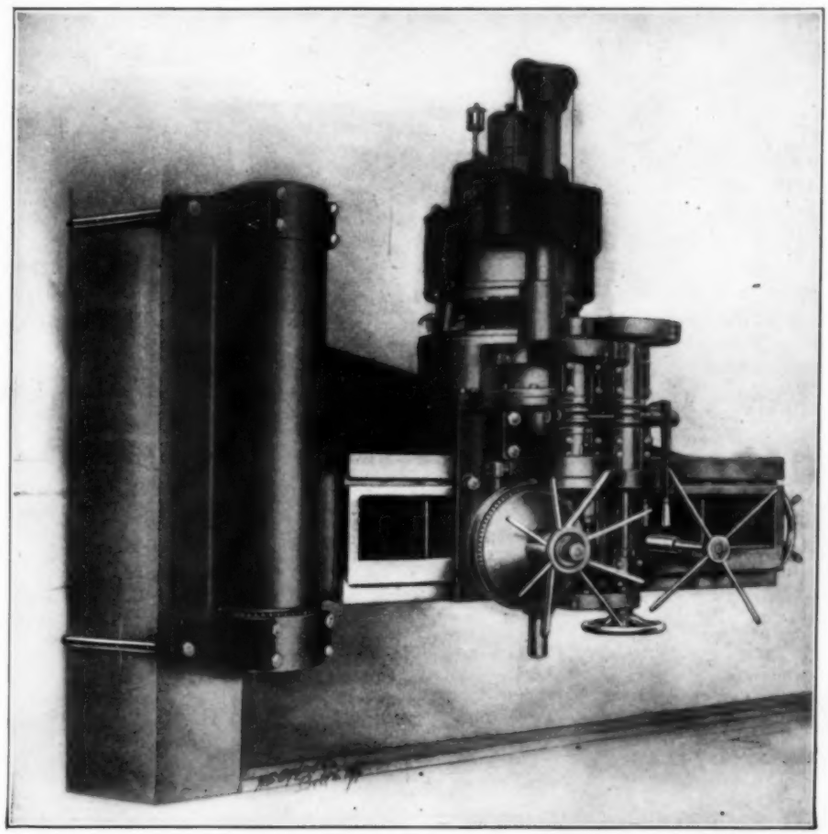


FIG. 2. NEW TURRET SLIDE

Heavy Duty Radial Drill

The accompanying halftone illustrates what the makers, the Detrick & Harvey Machine Company, of Baltimore, Maryland, call their "Dreadnaught" heavy-



HEAVY-DUTY RADIAL DRILL

duty radial drill. The type of machine illustrated is adapted for attaching to crosshead of gantry, building column or to a regular radial-drill column. It has a spindle 3½ inches in diameter, the vertical movement by hand or power having a range of 18 inches; four changes of feed are obtained, 1/132, 1/64, 1/32 and 1/16 inch per revolution of spindle. The machine is driven by vertical-type variable-speed motor furnishing spindle speeds from 100 to 400 revolutions per minute.

As will be noted from the illustration the radial arm is of massive box shape, the horizontal arm having a vertical face 24¾ inches deep, heavily braced to a cylindrical vertical portion which rests upon a ball-bearing seat in a pivot bracket, the vertical bearings both top and bottom also being provided with roller bearings. The radial drilling capacity of this machine ranges from 2 feet 6 inches to 6 feet 6 inches.

The motor is mounted on the drilling head and consequently drives directly to spur gearing in the ratio of 1 to 4 to the spindle; thus practically the full power of the motor is delivered at the spindle. Power consumption, through this method of direct drive, has been found economical, the elimination of gearing and transmission parts being a noticeable feature. The machine shown in the cut weighs, complete with motor, 16,000 pounds.

Duplex Type of Drilling Machine

In the accompanying halftone, Fig. 1, is shown the latest addition to the line of duplex type of drilling machines manufactured by the Moline Tool Company, Moline, Ill.

This machine is intended largely for pipe drilling and bar drilling where the holes are so close together that they cannot be reached at one setting. In this design the machine drills from each side of the pipe so that the time of the drill passing through the hole of the pipe is entirely saved; moreover, drilling from both sides throws the bur on the inside of the pipe where it has no objection. Drill breakage is avoided by the fact that the drill not going through the entire pipe does not strike the further wall, which is usually the cause of such breakage, and in addition a hollow spindle, a special chuck, and a straight-grooved drill are used, so that the drill projects beyond the chuck just far enough to pierce one wall of the pipe. Positive drive is obtained by the jaws of the chuck, and back slippage avoided by the threaded rod, as shown in Fig. 2. The drill operating so close to the work makes unnecessary the use of bushings or guides.

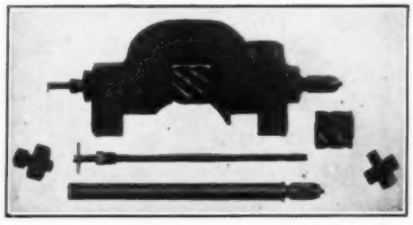


FIG. 2. DRILLING-HEAD DETAILS

The pipe is held in adjustable V-blocks and clamped by plunger rods which are connected to the rails. The heads are adjustable anywhere along the rails, and are driven by spiral gear as shown in Fig. 2. They have ball thrust bearings and bronze bushings. The feed is obtained by causing the rails to approach and recede from each other. An automatic stop is provided which will stop the feed at the back end of the stroke and can be thrown in or out at any point by the double-ended treadle shown.

The machine is furnished complete and is built in several sizes capable of driving drills from 3/16 inch up.

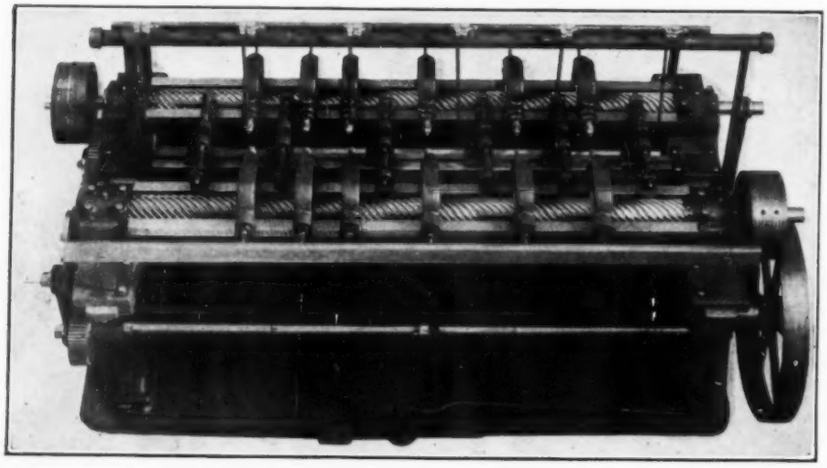
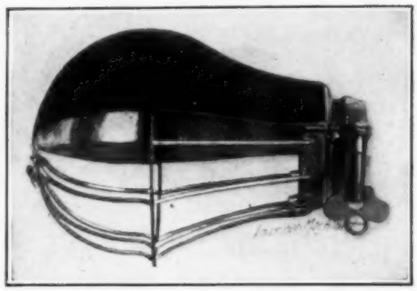


FIG. 1. DUPLEX DRILLING MACHINE

Reflector Lamp Guard

What is known as the Loxon reflector lamp guard is illustrated herewith. This improved form of guard enables the user to reflect light to any given point and to have his lamp guarded both from breakage and petty theft.

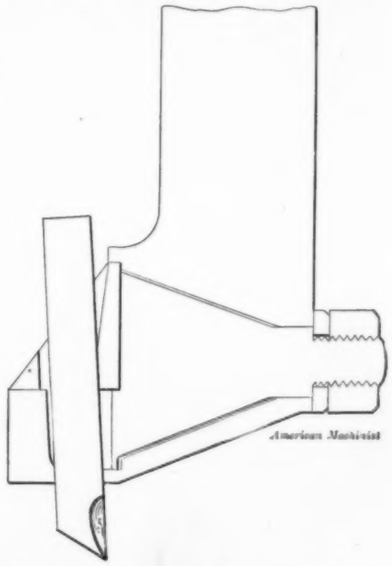


REFLECTOR LAMP GUARD

It is the latest form placed on the market by the McGill Manufacturing Company, Valparaiso, Ind.

Universal Draw Cut Tool Holder

The tool holder shown in the accompanying line cut is especially designed for planer, shaper and boring-mill work. Its construction will be readily understood from the sectional view shown,



SECTIONAL VIEW OF UNIVERSAL DRAW-CUT TOOL HOLDER

The shank is made heavy in order to carry a heavy cut, working on the side as well as straight down, the diameter of the swivel also being made large in order to provide necessary holding power to prevent crowding away from the cut.

The swivel works in a recess in the body of the holder and can be tightened up in any position in which the cutter

will be found to work to advantage. The rim of the body outside of the recess in which the swivel works is case-hardened so as to prevent wear.

It is self-tightening because the back end of the cutter bears on the triangular member of the swivel in such a way as to crowd the point of same against the other member. Thus the heavier the cut the harder the back of the cutter bears on the triangular swivel member and the tighter the swivel becomes in the recess of the body on the holder.

The action of the tool holder is similar to a draw cut because the cutter is placed back of the holder and in line with the pin in the clapper box of the machine, thus avoiding chatter.

The tool holder is made by the Universal Tool Company, Jamestown, N. Y.

Friction Back Geared Screw Machine

The accompanying halftone illustrates a new friction back-geared screw machine recently placed on the market by the Dreses Machine Tool Company, Cincinnati, Ohio.

The head and bed are cast in one piece and the friction back gearing is entirely inclosed. The frictions in the head are of the toggle-joint type and so designed that the entire operating mechanism can be put in place or moved without taking out the spindle. The frictions are powerful in gripping, easily adjusted and work noiselessly.

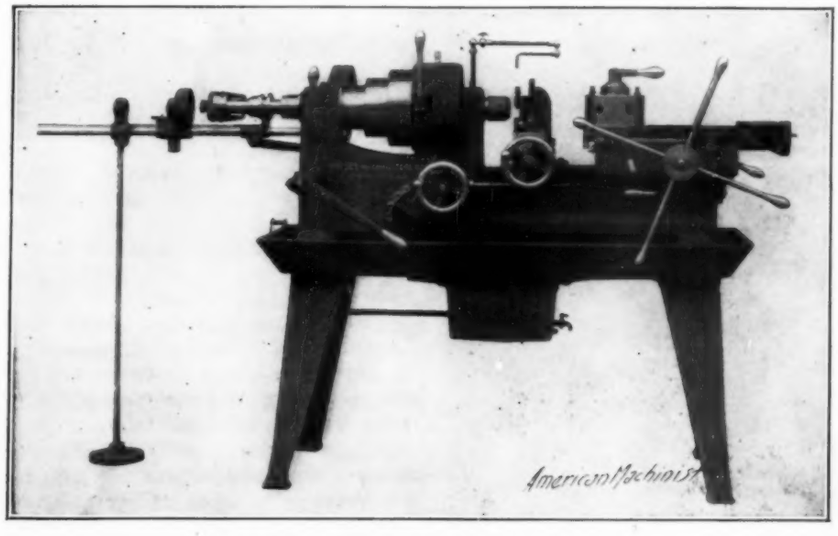
The spindle bearings are of babbitt metal spun in their seats. The spindle nose has two blank portions and the thimble or chuck does not depend on the threads for alinement. It is held very short to bring the tools close to the bearing.

The operating lever shown on the left is placed in a position where the operator with his left hand can exert considerable force with little effort. This handle is clamped on its shaft and may be adjusted so as to best suit the convenience of the operator.

The top slide of the turret is provided with six stops, one for each of the holes in the turret. This stop mechanism is placed in front and on the outside of the top slide and is operated by a cam placed at the bottom of the turret. The stop dog makes about one-quarter of a revolution and through an automatic locking plug can be instantly put out of action, so as to clear all six stops.

The cutting-off rest has longitudinal movements on the bed and the cross-feed screw is provided with a graduated dial on the hand-wheel hub.

The machine weighs about 1200 pounds and is built in four sizes, to take ¾-inch, 1-inch, 1½-inch and 2¼-inch through the wire-feed arrangement.

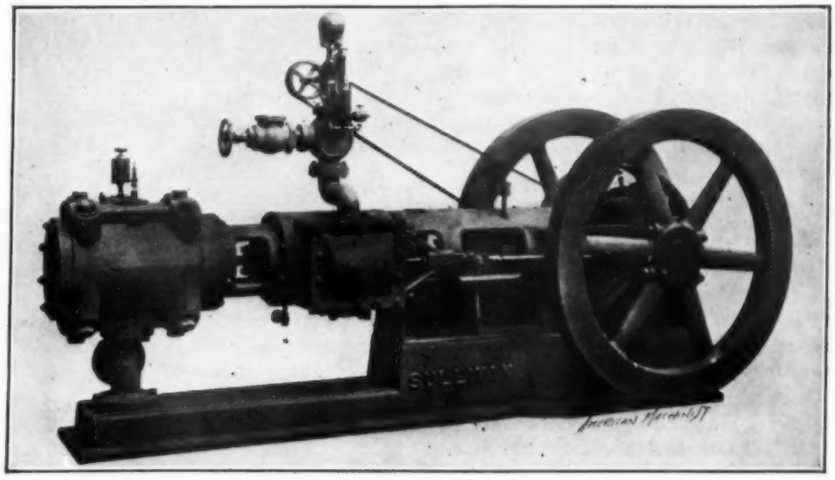


FRICTION BACK-GEARED SCREW MACHINE

Small Air Compressors

The accompanying halftone shows a new, single-stage, steam-driven air compressor now being manufactured by the Sullivan Machinery Company, Chicago. They are made in both steam- and belt-driven types. These machines are designed especially for work in foundries, machine shops and other places where careful attention is not expected. They are made in small and moderate sizes for various air pressures from 10 to 100 pounds per square inch. The machines are of the subbase construction, to form a rigid, self-contained unit. It is claimed that the design is especially adapted to durability and ease of adjustment of working parts. Air cylinder is water jacketed around the walls and both heads, and air valves are of the radial-poppet type for both inlet and discharge. The crosshead is of the box pattern, with adjustable shoes.

With the steam machines, an automatic pressure and speed governor is supplied, to maintain a constant air pressure and to keep the machine within safe speed limits. With the belt-driven machines, an unloading device is provided, if desired, for shutting off the incoming air and reducing the power when the receiver pressure exceeds a certain amount. Special units also can be furnished for direct electric and gasolene drives, when desired.



SULLIVAN AIR COMPRESSOR

Black and White Prints

The latest process for making black and white prints is that of the Black-on-White Reproduction Company, 61 Hanover street, Boston, Mass., who have a simple and interesting process. They have a paste or gelatin, which is heated and then poured on to a zinc or other slab of sufficient size for the desired prints.

A blueprint is first made, and after drying, is laid lightly on the prepared surface, special care being taken to go over the back of the whole print with the hand to insure perfect contact with

the paste beneath. This contact need be only for a moment, and it affects the paste so that only the lines of the blueprint will receive the printer's ink which is put on with a regular roller. The ink used may be of any color desired.

The print is obtained by laying the paper on the paste after it has been inked, and 50 to 100 copies may be made from one impression. After the work is done, the ink is removed from the paste by passing a dry roller rapidly over the surface. The paste can then be removed with a knife, put in a double boiler and melted over, ready to be used again. The plates are cleaned with benzine.

Automatic Sizing Grinder

The illustrations show some of the changes in the Pratt & Whitney automatic cylindrical-sizing grinder of the Niles-Bement-Pond Company, New York. A full description of the details of this machine can be found on page 11, Volume 30, Part 2.

After the automatic sizing device has been set to the required diameter, the machine will automatically grind any number of pieces to that diameter without regard to the wear of the grinding wheel. Some of the details of this mechanism have been improved, as shown in Fig. 1. The sizing device remains substantially as before.

In operation both roughing and finishing feeds are controlled and utilized. The wheel feed proper, may be operated entirely independent of the automatic sizing device. Both roughing and finishing automatic feeds are provided by means of separate feed pawls operating upon a ratchet. These feed pawls are entirely independent of one another, but derive their rotating action from the same connecting lever. A feed movement of from ½ to 12 notches is obtainable by means of conveniently located adjusting screws, which reduces the diameter of the work from 0.000125 to 0.003 inch. The finishing pawl is made double to permit the taking of a ½-notch feed when desired. The automatic feed may be instantly engaged or disengaged by a conveniently located knob or by the automatic sizing device.

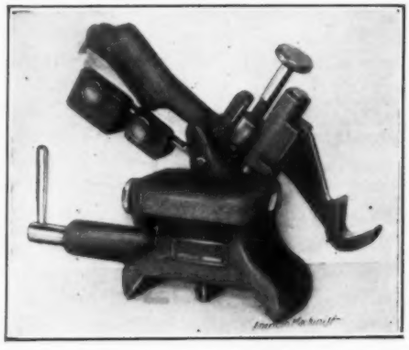


FIG. 2. IMPROVED BACK REST

Suppose roughing pawl *A* is set to feed eight notches, finishing pawl *B* to feed one notch, after which disengager *C* is located so as to disengage the roughing pawl within 0.001 inch of the finished size. After the roughing pawl has been disengaged, the finishing pawl continues to feed until disengaged by the automatic sizing device through the magnet, which is operated by a dry battery and whose one function is to disengage the fine feed pawl when the work has been reduced to the desired diameter. The electrical circuit is carried through the automatic sizing device, the magnet remaining inoperative due to a break between points in the automatic sizing device. The amount left for the finishing feed always remains the same, regardless of the wear of the wheel. In setting this device it is only necessary to grind a piece to the required size after which the proper adjusting of the sizing lever is promptly determined by means of the micrometer screw and dial which governs the transverse adjustment of the device, also an adjusting screw is provided in the sizing lever for very delicate adjusting.

The usual cumbersome overwork has been replaced by the simple countershaft shown, and the back rest has been improved as indicated in Fig. 2. In operation the back-rest shoe automatically follows up and supports the work throughout the grinding operation without any yielding, and at a pressure that is easily governed to meet any requirement. The relation between the work and the supporting shoe is maintained by the downward movement of the lever, which raises the shoe holder as the diameter is reduced. The downward movement allows the roll to take up the thrust as fast as the diameter of the work is reduced.

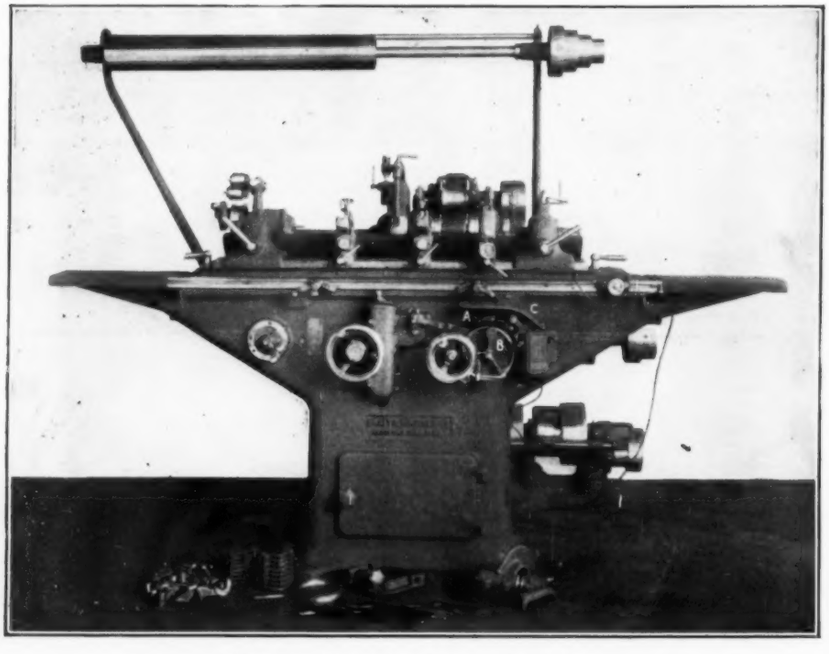


FIG. 1. AUTOMATIC SIZING GRINDER

A Special Spark Plug Wrench

J. H. Williams & Co., Brooklyn, N. Y., are making a special wrench, one end of which is a box wrench fitting the regulation-spark plug. The other end is a ⅜-inch open wrench fitting the standard tire lug.

Horizontal Boring, Milling and Drilling Machine

The machine illustrated herewith is the latest type brought out by the Cleveland Machine Tool Works, Cleveland, Ohio.

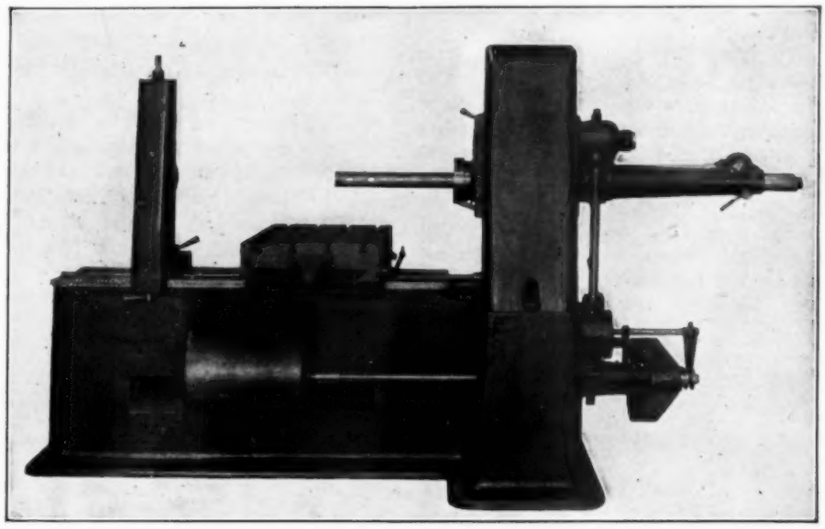
The machine is motor driven, using a 3-horsepower constant-speed motor, 1135 revolutions per minute, giving 12 speeds in geometrical progression; six direct and six with back gear.

It will be noted that the motor is bolted to the back of the bed, under a hood which protects it from chips and dirt, and drives through the horizontal shaft shown. The spindle runs in solid taper bronze bearings with adjustment for wear, and has a faceplate to receive large milling cutters, etc., for heavy work; it revolves in right- or left-hand directions, and can be started, stopped or reversed instantly, this being convenient for facing, tapping, milling and other operations. The spindle and back-gear drive is located between the spindle bearings, bringing the power direct to the work, thus relieving the outer shafts from unnecessary strain.

The lever for operating back gear and the lever for reversing spindle are conveniently located on the spindle head, and they can be engaged or disengaged while the machine is running. The spindle bar can be securely clamped for face-milling purposes and is operated from the pilot wheel for both hand feed and quick traverse by means of a clutch.

Platen and carriage adjustments are by micrometer dials, and the spindle head and outer support for boring bar are alined by means of scale and vernier reading 0.001. The scales read 1/64 inch and 1/100 inch. The outer support for boring bar can be clamped securely to the bed and is readily removed for overhanging work.

There are 16 head, platen and bar feeds, eight in number for each position of spindle back gear, are positive geared and arranged in geometrical progression from 0.005 to 0.3 inch per revolution of spindle.

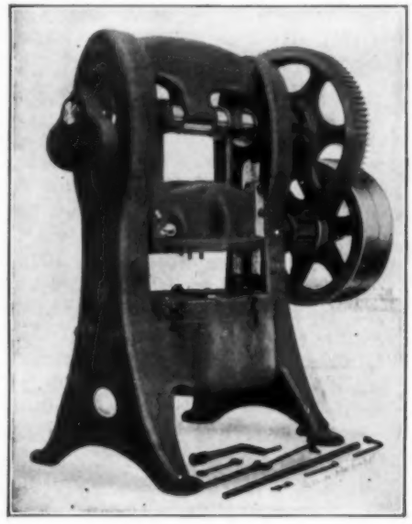


MOTOR-DRIVEN HORIZONTAL BORING, MILLING AND DRILLING MACHINE

A Powerful Ferracute Press for Armature Disks

The halftone shows a type S. G. 52 press built by the Ferracute Machine Company, Bridgeton, N. J. This press is for work such as notched armature disks where the quantity of one size required warrants the use of a die which produces a complete notched disk at each stroke.

The press shown measures 40 inches between the columns and has a round bed for the reception of the dies. The dies for cutting sheet metal are usually given shear thereby enabling comparatively light pressures to be used, but in the manufacture of armature disks it is better practice to have the cutting surfaces flat to avoid the inaccuracies in the product due to sheared dies. Where dies are made without shear, a press having considerable power is desirable.



A POWERFUL PRESS FOR ARMATURE DISKS

Beating the Inspector on Steel Tests

BY R. S. WILLIAMS

Professor Outerbridge's article on "Integrity of Tests of Metal" reminds me of methods that I knew some years ago.

During the '90's there flourished a rolling mill that named most of the great western railway companies as its customers. Its product was small and medium sized bars and rods, such as are used in car construction. It boasted of its heavy tonnage and—inside the circle of the knowing ones—of its ability to deceive any inspector who presented himself, armed with credentials, knowledge and his employer's private stamp, ready to pass upon the material before it was loaded aboard cars.

The way of doing this seemed a unique and bold piece of rascality. It was usually done in about this way:

Word would be sent the customer that a shipment would be ready at a certain time. The inspector arriving would be shown the stock and make selection of samples. As a careful inspector he followed them to the shears and watched them cut to convenient lengths for handling in the lathe and testing machine. Each test piece he then stamped several times and carefully replaced the stamp in his pocket or hand satchel, and awaited the preparation of the pieces on the lathe. The next move was to tell the inspector that the pulling could not well be done till the following forenoon—possibly this had been arranged so that it would come on Saturday, and thus make it necessary to do the testing Monday.

In the interval the inspector was used as well as a prospective customer. He was given the best of smoking. He was properly moistened, etc., etc., etc.

While all this was in progress a duplicate stamp was being made from the impressions left in the test pieces. On its completion it was used to stamp similar sized pieces, sheared from what was known to be very superior stock—some that was kept for that purpose only.

These pieces of extra good stock were then turned to the proper size and awaited the return of the inspector, who witnessed their properties as exhibited on the testing machine, and carried away a sample to show the character of the fracture. The shipment was then made.

It will be seen that succeeding orders from the same customer could be handled without the expense of a duplicate stamp, providing the former duplicate was preserved and an inspector came again with the old stamp. I have seen a chest full of such stamps with the various initials of railway and other companies who were large consumers of bar iron and steel.

This account would be more complete if I told of the ultimate overthrow of each and all engaged in such criminal practices, but I cannot testify to anything of the sort.

Inspectors should take warning from this and not put their trust in stamps, but watch the samples all the way from the shears to the testing machine.

The two largest reinforced concrete oil reservoirs in the world are now nearing completion at San Luis Obispo, Cal. Each of the reservoirs is 601 feet inside diameter and 20 feet 4½ inches high above grade. When filled, each of the two huge tanks will hold more than 1,000,000 barrels of oil.

Loose Leaf System of Filing Drawings

By L. E. Clinton

A convenient filing system for use where the majority of drawings are of small size.

Method of indexing and allowing for alteration of drawings.

To those who have to do with the filing of drawings, tracings and blueprints, the following description will undoubtedly be of value.

One of the features of this system of filing drawings is that each section can have at least 99 parts of the same classification.

To begin with, the machine is divided up into groups taken in their order of assembling, or as the design of the machine warrants. For our use, we have divided the machine into 18 sections, the sections being numbered from 100 to 1800. The parts are also classified as to their mechanical make up; as, shafts, punchings, castings, bushings, etc., and are likewise lettered A, B, C, D, etc. The reader readily will see that by this system the drawings can be cross indexed so that part 1206-C would be a casting in the 1200 section.

By referring to the accompanying lists, the complete method of classifying the parts is seen. The section numbers are tabbed off on the right-hand edge of the sheets, while the classification letters are on the top edge. This allows of the drawings and tracings being left full on the edge, and also makes it convenient to file them in ordinary letter files. The full size of our sheets is about 8x12, although they may, of course, be made any size to suit the size of the machine or parts to be drawn.

It has been necessary for us to have some larger sheets than the 8x12 size, but it is very easy to so arrange the drawing that the blueprints can be folded to go in our folders with the regular 8x12 sheets.

To make the system complete it is necessary to be able to give numbers to the sub-sections also, and this we do by marking the sub-sections something like this: Sub-section number 1 in section 14 would be marked 14—1; sub-section number two would be marked 14—2, etc.

Sub-assembles also have their own markings. Blank 407-B might be assembled to three different bushings. The first assembly would be 407-B 1, the second assembly would be 407-B 2, etc. Alterations or changes to drawings are taken care of by placing a decimal figure after the regular number, and marking each change to the same part with the next highest number. The first alteration to part 407-B would show up 407.1-B, the second alteration 407.2-B, etc.

Our blueprints are placed in ordinary loose-leaf transfer files, and a book of prints given to each foreman requiring them.

By referring to the accompanying cuts, the method of filing in the letter files will plainly be seen; also the loose-leaf books.

A list of parts precedes each section in the book of blueprints.

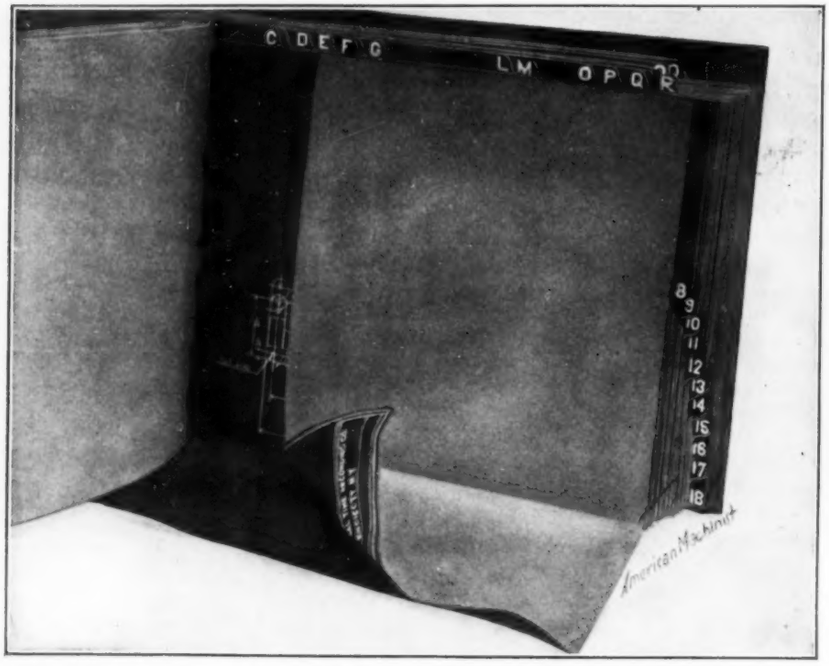


FIG. 1. BLUEPRINTS BOUND IN LOOSE-LEAF BOOK

SECTIONS

100 Top plate and operating handle.
200 Case.
300 Side and center frames.
400 Impulse mechanism.
500 Magnet drive.
600 Ribbon-feed mechanism.
700 Pin boxes.
800 Punches and frames.
900 Printing and punching mechanism.
1000 Typewheels.
1100 Selector, differential and time of day racks and levers.
1200 Time of day gear and ratchet selectors and crossovers.
1300 Indicator wheels and cams.
1400 Feed-pawl frame and pawls for indicator wheels.
1500 Retaining pawls for indicator wheels.
1600 Time of day cam wipers.
1700 Main cam shaft.
1800 Noon-hour cut out, elimination wheel, etc.

CLASSIFICATION OF PARTS

A—Shafts, tie bars, spacing bars and short rods.

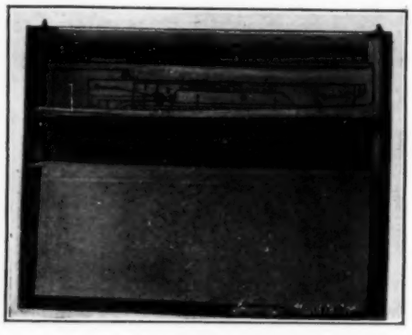


FIG. 2. BLUEPRINTS FILED IN LETTER-FILE TRANSFER BOX

B—Punchings.
C—Castings.
D—Bushings.
E—Rollers.
F—Washers, collars, spacers and tubes.
G—Studs.
H—Rivets.
I—Dowel pins.
J—Spring pins.
K—Taper pins.
L—Staking pins.
M—Springs.
N—Lock rings.
O—Nuts.
P—Screws.
Q—Miscellaneous.

Increasing Shop Capacities

Metal Working

News items for the sales department — where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip — facts

NEW ENGLAND

The Exeter Machine Works is building a new factory at Hyde Park, Mass.

The New London (Conn.) Ship and Engine Company is building a new machine shop.

Genther & Stevens, 113 Haverhill street, Boston, Mass., are in the market for an automatic screw machine.

The National Metallic Bed Company, of Boston, Mass., will erect a plant, including foundry, at Everett, Mass.

The Miner & Peck Manufacturing Company, New Haven, Conn., building presses, is making additions to its plant.

The National Machine and Tool Company, 253 A street, Boston, Mass., is in the market for a metal planer, 24x24 inches x 10 feet.

The Peck, Clark Company, Brookfield, Vt., is planning the erection of a factory at Hartford, Vt., for the manufacture of hoes, rakes, etc.

The Aëroplane Company of America, with offices in the John Hancock building, Boston, Mass., is seeking site on which to erect a plant.

The Gullen Manufacturing Company, Worcester, Mass., is to have a branch plant of its iron works erected at South Framingham, Mass.

MIDDLE STATES

The Dean Forging Company, Muncie, Ind., will enlarge its plant.

The Standard Oil Company, Bayonne, N. J., will erect a $100,000 can factory.

The Seager Engine Works, Lansing, Mich., will erect an addition to its plant.

The West Steel Casting Company, Cleveland, Ohio, will erect a new foundry building.

The Reflector and Hardware Specialty Company, Chicago, Ill., will erect a two-story factory.

The Cohoes (N. Y.) Rolling Mill Company is preparing to equip part of its plant as a pipe-threading shop.

The plant of the Eclipse Brass and Aluminum Foundry Company, Bradford, Penn., was destroyed by fire.

The Imperial Car Company, Cincinnati, Ohio, will erect a large garage and repair shop on Madison road.

The Herr Automatic Press Company, Philadelphia, Penn., has purchased site on which a new plant will be erected.

Joseph Obenberger & Sons, Milwaukee, Wis., will build an addition to their forge works at Barclay and Ferry streets.

The Ohio Electric Car Company, of Toledo, Ohio, has increased its capital stock and is planning the erection of a new plant.

The Columbus (Ohio) Machine Company is seeking another location for a plant for the manufacture of gas engines and motor trucks.

The Hollinger Cutlery Company, Fremont, Ohio, is said to be considering the removal of its plant, having outgrown its present quarters.

The Gould Coupler Company, Depew, N. Y., which is erecting a new plant at Buffalo, is arranging for the purchase of necessary equipment.

C. B. Atterbury, of Hillsboro, Ill., is considering the establishment of a factory for the manufacture of certain lines of farm machinery.

The main building of the Gowanda (N. Y.) Agricultural Company was destroyed by fire, causing a loss of $25,000. The company manufactures plows.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids January 10, for one bolt-heading machine as per Schedule No. 3208.

The Baltimore & Ohio Southwestern Railroad Company has purchased site at Cincinnati, on which it is said large repair shops and roundhouse will be erected.

The Croxton Motor Company, Massillon, Ohio, has been incorporated with $25,000 capital to manufacture motors. Incorporators, E. A. Croxton, H. D. Michaels, J. P. Stolz, etc.

The Arnold-Sandberg Machine Company, Terre Haute, Ind., has been incorporated to manufacture traction engines. Capital, $50,000. Incorporators, D. B. Arnold, H. M. Sandberg, C. O. Sandberg.

The Peoria Metal Culvert Company, of East Peoria, Ill., has been incorporated to manufacture corrugated metal culverts. Capital, $40,000. Incorporators, A. B. Fink, F. J. Feldt, W. V. Tefft.

The Weller Hardware and Foundry Company, Horseheads, N. Y., has been organized to manufacture hardware, etc. Capital, $20,000. Incorporators, H. J. Weller, Frank L. Matthews, Wm. W. Myers.

The Beloit (Wis.) Lighting and Heating Company, recently organized for the manufacture of lighting outfit, has leased a building for which equipment will be needed, including lathes, drills, etc.

The Gardner Grain Weigher Company, Ottawa, Ill., has been incorporated to manufacture grain-weighing devices, etc. Capital, $25,000. Incorporators, W. C. Vittum, C. B. Chapman, Duncan McDougall.

The Hart & Crouse Company, Utica, N. Y., manufacturing furnaces, has decided to increase its capital stock from $226,000 to $650,000, for the purpose, it is stated, of enlarging its manufacturing facilities.

The Grieve Grate Company, New York, has been incorporated to manufacture grates and stove supplies. Capital, $100,000. Incorporators, Chas. E. Bedford, 26 Broadway, New York; Wm. C. Crosby, Essex Falls, N. J.

The Loraine Development Company, Albany, N. Y., has been incorporated to manufacture machinery, etc. Capital, $60,000. Incorporators, S. A. Murphy, 79 Chapel street, Albany; Wm. Hurst, Jr., Hurstville, N. Y.

Atlas Auto and Supply Company, Cincinnati, Ohio, has been organized to operate a garage and repair shop and handle accessories. Incorporators, H. W. Weiland, Hans Richard, Harold B. Gibbs, etc. Capital, $10,000.

The P. J. O'Rourke Electrical Engineering Company, Brooklyn, N. Y., has been incorporated to manufacture and deal in electrical machinery, etc. Capital, $25,000. Incorporators, P. J. O'Rourke, B. C. King, J. C. Totten.

The Enterprise Electric Fixture Company, Cleveland, Ohio, has been incorporated to manufacture and sell all kinds of electrical fixtures and equipment. A. L. Oppenheimer, Edward Younger, W. K. Caldwell, etc., incorporators. Capital, $10,000.

Cordeaux-Etter Air Pump Company, Brooklyn, N. Y., has been incorporated to manufacture air pumps, etc. Capital, $10,000. Incorporators, G. E. Cordeaux, 1127 Hancock street; Louis Etter, Jr., 26 Irving place; Wm. A. Etter, 1020 Kent avenue.

The H. Bieder Manufacturing Company, Ashtabula, Ohio, has been organized with $10,000 capital, to manufacture gasolene engines and similar machinery. H. Bieder, F. A. Mason, Mrs. M. E. Mason, Lizzie J. Bieder and A. Roth, incorporators.

Dawson, Pyles & Putschky, Fulton, N. Y., have incorporated to manufacture dump cars, general contractors' supplies. Capital, $15,000. Incorporators, Chas. B. Dawson, 113 Rochester street; V. A. Pyles, 510 Rochester street; John Putschky, 113 Rochester street.

The Dowdall Manufacturing Company, Brooklyn, N. Y., has been incorporated to manufacture electric pressing irons, etc. Capital, $10,000. Incorporators, John F. Linton, James F. Dowdall, Glen Morris, N. Y.; B. F. Hamm, 522 West One Hundred and Forty-fifth street, New York.

SOUTHERN STATES

The Spalding Foundry Company, Atlanta, Ga., will build a new plant to replace the one recently burned.

The National Refrigerator and Butchers' Supply Company, of Memphis, Tenn., is desirous of securing a location between St. Louis and Chicago, on which to erect a plant.

WEST OF THE MISSISSIPPI

The Duluth Iron and Metal Company may establish a plant at West Duluth, Minn.

J. H. Furtney and J. P. Russell will erect a two-story machine shop at Glenwood, Minn.

The United Casting Company, Los Angeles, Cal., is building an addition to its foundry.

The Union Pacific Railroad is to enlarge its roundhouse and make other improvements at Nevado, Mo.

Sander Lurs, of Clara City, and Edward Fitzpatrick will erect a blacksmith shop at Raymond, Minn.

The Osborn Pump Works, of Virginia, Minn., is planning the establishment of a plant at West Duluth.

The St. Louis & San Francisco Railroad will erect a roundhouse, forge and machine shop at Lawton, Okla.

S. C. Haver, Redlands, Cal., has taken out a permit to erect a commercial garage. Modern repair machinery will be installed.

The Bridgeman & Russell Company, Du-

luth, Minn., will erect a large blacksmith shop in connection with its new stable.

B. Doremus, Hollywood, Cal., will establish a commercial garage and repair station. Modern repair equipment will be installed.

The J. B. Klein Company, Oklahoma City, Okla., manufacturing ornamental iron and wire products, will erect a two-story addition.

The Woods Electric Car Company has been incorporated at Los Angeles, Cal., by R. S. Fend and E. D. Rogers, with a capital of $10,000.

Levereau & Russell, San Bernardino, Cal., will build a commercial garage and repair station. Modern repair machinery will be installed.

The Imperial Iron and Machine Company has been incorporated at Los Angeles, Cal., by L. V. Boggs and W. P. W. Martin, with a capital stock of $25,000.

The Wagner Brothers Company, Omaha, Neb., has been incorporated by Chas. A. Wagner, Wm. C. Wagner and Avery Lancaster to manufacture machinery and vehicles. Capital, $20,000.

The Stetson-Ross Machine Works, Seattle, Wash., will increase the capacity of its plant and is also planning to establish a factory at Vancouver, B. C. The company manufactures lumber machinery.

The Universal Motor Company has been incorporated under the laws of Arizona, with $5,000,000 capital for the manufacture of a large motor truck under a new patent. Temporary quarters are in Indianapolis, Ind. Frank H. Summerill, of Denver, Colo., is president.

CANADA

The Grand Trunk will equip a large new machine shop at Belleville.

The Grand Trunk is building large new shops at Richmond, Quebec.

The C. P. R. will extend its roundhouse and shops at Calgary, Alberta.

The Dominion Iron and Steel Company, of Sydney, N. S., is extending its plant.

The International Tool Steel Company is building a new plant at Port Hope, Ont.

The Nova Scotia Car Works, of Halifax, N. S., will build large extensions to its plant.

General Manufacturing

NEW ENGLAND

The Sidney Blumenthal Company, Shelton, Conn., will install a boiler.

The Star Webbing Company, Brockton, Mass., is building a new factory.

The Lapworth Webbing Company, Brockton, Mass., is erecting an addition.

The Sea Coast Canning Company will erect a canning plant at Eastport, Me.

The F. M. Hodgdon shoe factory, Haverhill, Mass., was badly damaged by fire.

Geo. L. Osgood, Ayer, Mass., is building a factory for manufacturing leather.

G. L. Winn intends to open a comb factory at Leominster, Mass., in January.

The French Worsted Company, Woonsocket, R. I., will install a new generator.

The City Mills Woolen Company contemplates locating a plant at Franklin, Mass.

The General Hospital, Greenwood, Conn., is building an addition to be used as a laundry.

The Superior Laundry Company, of Springfield, Mass., has purchased site for a new plant.

The Lowell (Mass.) Felt Company has been incorporated for the manufacture of felt goods. Dwight Smith, treasurer.

The Commonwealth Shoe and Leather Company, Whitman, Mass., will install a steam engine.

The city of Norwich, Conn., will need additional equipment for its municipal electric-light plant.

The Cremo Brewing Company, New Britain, Conn., will make an addition to its cold-storage building.

The Edgar K. Ray Estate, Woonsocket, R. I., is building a four-story addition to its cotton-waste mill.

The city of Hartford, Conn., will erect a technical high school and will require boilers, engine and pumps.

The Royal Worcester Corset Company, Worcester, Mass., contemplates erecting a large addition to its present factory.

The plant of the Stevens Oyster Company, including machinery, at Rowayton, Conn., was destroyed by fire. Loss, $25,000.

The Masachusetts Cotton Mills, Lowell, Mass., has taken out permits for the erection of a large boiler house and coal pocket and two dye-house additions.

The New England Sanitarium, Melrose, Mass., is in the market for a deep well pump for a 6-inch well 400 feet deep, and a pneumatic storage of at least 5000 gallons capacity.

The Krippendrof-O'Neal Shoe Company and the Cahill Shoe Company, of Cincinnati, whose plants recently burned, are said to be considering to locate in some other place, preferably in New England.

The Pilgrim Mills, Fall River, Mass., is being incorporated with $1,050,000 capital. William C. Hawes, of New Bedford, will be president. Plant for the manufacture of fine cotton goods will be erected.

The Hampden Manufacturing Company, Springfield, Mass., has been incorporated to manufacture cotton, silk, woolen and flax goods. Capital, $25,000. Incorporators, Ivan J. Amo, Wm. B. McCourtie, Edward Wennisch, etc.

The United States Fibre Products Company, Providence, R. I., has secured the old factory of the Providence Spool Company. Will enlarge and equip same for the manufacture of fiber and electrical goods for the automobile trade.

MIDDLE STATES

Mr. Anderson will erect a sawmill at Armstrong Creek, Wis.

The National Wood Dish Company, Thompsonville, Mich., will extend its plant.

The Wm. Simon Brewing Company, Buffalo, N. Y., will erect a bottling works.

The Crawshaw-Carpet Works, at West Newburgh, N. Y., is being enlarged and improved.

The plant of the Toledo (Ohio) Biscuit Company was destroyed by fire. Loss, $225,000.

Fire destroyed the basket factory of Prasse & Sausts, at South Euclid, Ohio. Loss, $11,000.

The Webber Manufacturing Company, Milwaukee, Wis., will erect a planing mill and factory.

Endicott, Johnson & Co., Endicott, N. Y., has plans for an extensive addition to its shoe factory.

Armour & Co., of Chicago, Ill., will establish a $75,000 cold-storage plant at Chattanooga, Tenn.

C. E. & B. J. Johnson, Milwaukee, Wis., will erect two large buildings for the manufacture of soap.

The Husted Milling Company, Buffalo, N. Y., will erect an addition to its feed mill and elevating plant.

The Jacksonville (Fla.) Glass Company, a new concern, will shortly commence the erection of a plant.

The furniture factory of Chas. Estleman, 338 South Eighth street, Ann Arbor, was destroyed by fire.

Fire destroyed the plant of the Holly Milling Company and lighting plant at Holly, Mich. Loss, $40,000.

J. C. Parker Sons & Co., New Castle, Del., is remodeling and making additions to its factory and power plant.

The city of Waupaca, Wis., will buy power equipment for a new high school, including high-speed engines, motors, etc.

Fire destroyed the plant of the Friedlander Leather Remnant Company, 1114-18 North Bodine street, Philadelphia, Penn.

The plant of the Mt. Vernon Window Glass Company, of Mt. Vernon, Ohio, which was totally destroyed by fire, will be rebuilt at once.

The Black Diamond Coal and Coke Company, of Columbus, Ohio, will rebuild tipple and power house recently burned at Lathrop, Ohio.

Fire did $50,000 damage to the engine house and soldering department of the Art Metal Construction Company, Jamestown, N. Y.

The Berlin (Wis.) Brewing Company will remodel its plant and will purchase new power equipment, including engines and boilers.

At Cleveland recently fire destroyed the plant of the Gabriel Horn Company, located at 1407 East Fortieth street, entailing a loss of $75,000.

The Fireproof Film Company, Rochester, N. Y., has let contracts for the construction of a plant to cost about $200,000. Offices are at 27 Church street.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids January 17, for two sets of refrigerating machinery. Schedule No. 3227.

The Reilly Shoe Company, of Columbus, Ohio, will soon start the erection of a large addition to its plant in South Front street, which will almost double its capacity.

The main building of the Sunnyside Distilling Company, at Elrama, Penn., was destroyed by fire. Loss, $75,000. The plant is controlled by Howe Brothers, Cincinnati, Ohio.

The Gogebic & Iron Counties Railway and Light Company, Ashland, Wis., will erect a dam and power plant at Mellen, Wis., for which D. W. Mead, of Madison, is preparing plans.

The plant of the Plymouth Parlor Frame Company, Plymouth, Wis., was not destroyed by fire as stated in a previous issue. It was the plant of the Western Parlor Frame Company that burned.

The Columbus (Ohio) Carbureter Company has been incorporated to manufacture carbureters for automobiles. Capital, $10,000. Incorporators, John T. Adams, J. A. McDowell, D. H. Thomas, etc.

Federal Water-Proofing Company, Akron, Ohio, has been organized with $100,000 capital to manufacture and sell all kinds of water proofing. H. B. Ball, W. H. Miller, F. S. Nash, etc., incorporators.

The Greenfield Telephone Company, Greenfield, Highland county, Ohio, has been formed to build and operate a telephone plant. Capital, $100,000. Incorporators, Fay Baldwin, William J. Baer, D. O. Miller, etc.

Atterbury Brothers, Inc., New York, has been organized to manufacture and deal in paper. Capital, $100,000. Incorporators, R. B. Atterbury, Montclair, N. J.; J. H. Atter-

bury, Summit, N. J.; J. A. Howard, Brooklyn, N. Y.

The Swan Creek Lumber and Supply Company, Toledo, Ohio, has been incorporated to manufacture and sell lumber and builders' supplies. E. J. Marshall, W. G. Nichols, G. M. Reswick, B. F. Longnecker and H. H. Fraser, incorporators.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids January 10, for 2880 hacksaw blades, emery cloth, twist drills, files, reamers, metal scrapers, machinists' sets (schedule 3221), pulley blocks (schedule 3217), steel or wrought-iron pipe, angle valves (schedule 3215).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids January 10, for 10,000 pounds rough steel forgings (schedule 3213), 4200 pounds sheet brass (schedule 3216), 15,800 pounds medium bar steel, steel angles (schedule 3224), 1500 pounds medium high-speed tool steel, carbon tool steel (schedule 3225).

SOUTHERN STATES

Adel, Ga., will install a new Corliss engine in the electric plant.

Christensen & Satterwhite will install an electric-light plant at Erin, Tenn.

The Davis Hosiery Mills, Chattanooga, Tenn., will build a two-story addition.

A refrigerating machine will be installed in the Tulane hotel, Nashville, Tenn.

The Fayette Lighting Company, Lexington, Ky., is having plans prepared for an electric power plant.

The Narrows (Va.) Milling Company will install machinery for the manufacture of barrels, nail kegs, etc.

The H. L. Judd Company, East Chattanooga, Tenn., will rebuild its curtain-pole plant, recently burned.

The Maryland Bleacher and Dyeing Works, Baltimore, Md., will erect a new plant at Hudson and Streeper streets.

The chair factory of the Cramer Furniture Company, at Thomasville, N. C., was destroyed by fire. Loss, $150,000.

The Hagertown (Md.) Combination Heater is being incorporated with $30,000 capital to manufacture a furnace invented by G. Frank Lidy, of Waynesboro.

WEST OF THE MISSISSIPPI

O. T. Walker, of Sylvanite, Mont., will erect a sawmill.

William Poesch, of Columbus, Neb., will erect a candy factory.

W. H. Morrison & Co. will erect a 40-ton ice plant at San Benito, Tex.

The Harlingen (Texas) Brick Works will double the capacity of its plant.

Henry Lahiff, Placerville, Cal., is planning to erect a hydroelectric plant.

J. L. Lambirth, La Grande, Ore., contemplates the installation of a gas plant.

A. L. Raplee, San Juan field, Utah, will install a pumping plant in this district.

The Inland Empire Company, of Spokane, Wash., will erect two plants for paper mills.

The city of Glendale, Ore., will issue bonds for improving and enlarging its water system.

The Oakland Traction Company, Oakland, Cal., will expend $250,000 in new rolling stock.

The Long Beach Brick Company, Long Beach, Cal., is making improvements in its plant.

The electric-light plant at Orleans, Neb., was wrecked by an explosion. Will be rebuilt at once.

The Pacific Lumber and Manufacturing Company, Portland, Ore., is installing new equipment.

L. J. Thomas, Imperial, Cal., is at the head of a project to build a cotton-seed oil mill in this section.

The C. Shenkberg Company, of Sioux City, Iowa, has plans for the construction of a power plant.

A franchise has been granted to John I. Moore to erect an electric-light plant at Berthold, N. D.

A. C. Garde, Nelson, B. C., will erect a 250-ton electrolytic amalgamating plant on Graham's island.

Drewry & Sons, St. Paul, Minn., will erect a $10,000 bottling house on Payne avenue, near Minnehaha.

The oil refinery of F. R. Haley, Santa Fe avenue, Los Angeles, Cal., was considerably damaged by fire.

The Co-operative Hardware Floor Company, Los Angeles, Cal., is increasing the capacity of its plant.

The Santa Barbara Gas and Electric Company, Santa Barbara, Cal., will build a gas plant to cost $7000.

The Pomona College, Claremont, Cal., will increase the capacity of its power plant and erect a steam laundry.

The plant of the Great Western Cereal Company, of Fort Dodge, Iowa, was destroyed by fire. Loss, $50,000.

The Church Water Company, Riverside, Cal., will make improvements in its pumping and irrigation equipment.

Matthews & Loughlin, Eagle Cliff, Wash., will establish a saw mill, shingle mill and box factory at Eagle Cliff.

The sawmill and planing mill, of the Gooding & Nyirea Lumber Company, at Wittenberg, Wis., was destroyed by fire.

The Santa Barbara Gas and Electric Company, Santa Barbara, Cal., will build an addition to its power house.

The city of Fergus Falls, Minn., is considering the erection of a steam turbine or gas plant for the lighting system.

The Southern Pacific Railroad will erect a large treating plant in connection with its shops at Santa Barbara, Cal.

Enrique Schondube, Mexico City, Mexico, is at the head of an enterprise to build a hydroelectric plant in Durango.

The Oregon Power Company, Eugene, Ore., will build a hydroelectric plant on the McKenzie river to cost $1,000,000.

The city of Santa Ana, Cal., contemplates the installation of new pumping equipment. Bonds for $35,000 will be voted.

The Minnesota Canal Power Company, of Duluth, is planning to construct an 80,000-horsepower electric power plant.

The Ramona Power and Irrigating Company, Riverside, Cal., will build a power plant in the San Jacinto mountains.

Equipment will be required in the new manual-training school to be erected at Hollywood, Cal. N. F. Marsh, Los Angeles.

The Thompson Falls Water Power Company, Thompson, Idaho, is planning to extend its transmission lines to Murray, Idaho.

The Stayton Electric Light Company, Stayton, Ore., has purchased sites on the Santian river, and will build a hydroelectric plant.

The Steptoe Smelting Company, operating at McGill, near Ely, Nev., will equip its plant with oil-burning apparatus, abolishing coal.

The Northwestern Pacific Railway Company, Sausalito, Cal., is in the market for electric equipment for its Alto power plant.

The Milwaukee Lumber Company, St. Maries, Idaho, has practically completed its new main mill. A planing mill be erected in a short time.

The Toltz Engine Company, of St. Paul, W. E. King, superintendent, has commenced the erection of an electric plant at Brainerd, Minn.

The Amador Mines, Power and Water Company, Jackson, Amador county, Cal., will build a 2000-horsepower hydroelectric plant on Sutter creek.

The Los Angeles Market Company, Los Angeles, Cal., have taken out a permit to erect a warehouse to cost $129,000. Modern equipment will be installed.

The plant of the Hardwood Door Company, of St. Paul, Minn., was destroyed by fire. Loss, $50,000. Will be rebuilt. Temporary office, 185 West Seventh street, St. Paul.

The Nacogdoches (Tex.) Ice and Cold Storage Company has plans completed for the erection of two additional buildings, a boiler room and steam room.

Clay Brothers, of San Angelo, Tex., have been granted a franchise to establish an ice factory and electric-light plant at Fort Stockton, Tex.

The city of Phœnix, Ariz., will install a large pumping plant as provision against draft, raising water from the sands of the river bed.

The Fresno-Hanford Interurban Electric Company, Fresno, Cal., will build a power plant near Fowler, Cal. About $100,000 will be expended.

The Telluride Association, Payette, Idaho, will build a hydroelectric plant of 10,000 horsepower, on Snake river; $2,000,000 will be expended.

G. H. Webster, Jr., Denver, Colo., is planning for extensive irrigation work in the vicinity of Raton, N. M.; 76,000 feet of pipe will be required.

The Air-cooling Refrigerting Company has been incorporated at Los Angeles, Cal., by F. P. Sargent, F. A. and E. M. Brown, with a capital stock of $100,000.

Modern equipment will be installed in the warehouse and factory building being erected at Los Angeles, Cal., by S. R. Smith. Erection of building has begun.

The Santa Maria Midway Oil Company, operating in the Midway field, Kern county, Cal., is making extensive improvements and additions to its equipment.

The Corn Products and Refining Company, St. Louis, Mo., has commenced the erection of a $100,000 addition to be used for the manufacture of white syrup.

The Campbell Grain and Milling Company has been incorporated at Los Angeles, Cal., by D. E. Campbell and V. L. Gibson, with a capital stock of $50,000 fully subscribed.

E. H. Lancaster, Denver, Colo., is engineer for a two-story creamery to be erected at Alliance, Neb.; 225-horsepower boilers, 40-ton ice machine, dynamo, motors, etc., will be installed.

The ice house of the Pacific Fruit Exchange Company, Truckee, Cal., was destroyed by fire. Two thousand dollars in machinery for hoisting and storing ice was demolished. Entire loss, $10,000.

The Pachuca Light and Power Company, a subsidiary of the Mexican Light and Power Company, operating in the Pachuca district, Hidalgo, Mexico, will make extensive extensions in its system.

The Nevada United Mines Company, operating at Ward, near Ely, Nev., is planning

to build a railroad from its mines to the Nevada Northern in Steptoe valley. Construction will begin in spring, 1911.

Power plant and laundry equipment will be required in the new San Francisco Hospital to be erected on Twenty-third street. Plans are now being prepared by A. I. Coffey, architect, San Francisco, Cal.

John K. Sterling and Wilson Sterling, 4159 Eastern avenue, St. Louis, Mo., are said to be investigating throughout the Central West preparatory to securing site for a plant for the manufacture of a new storage battery.

The Yaqui River, Land and Irrigation Company, operating in Sonora, Mexico, and the Richardson Construction Company, Douglas, Ariz., are planning extensive irrigation work in this section. A power plant will be built in Cochise county, Ariz.

CANADA

Winnipeg will buy a large number of water meters.

Dundas, Ont., will equip a hydroelectric station.

Barrie, Ont., will equip a hydroelectric power station.

Brockville, Ont., will equip a hydroelectric power station.

Harriston, Ont., will spend $35,000 on a new waterworks system.

Lethbridge, Alberta, will spend $700,000 on a new waterworks system.

The town of Saskatoon, Sask., will install an electric railway system.

Montreal will spend nearly $2,000,000 equipping a filtration plant.

The town of Meaford is in the market for street- and road-making machinery.

The Vancouver Furniture Company, of Vancouver, B. C., is extending its plant.

The Sunset Sash and Door Company, of Vancouver, B. C., is extending its plant.

The Consumers Gas Company, Toronto, Ont., will build a governor house to cost $14,000.

The Bourget Brick Manufacturing Company will locate a large plant at Bourget, Ont.

The Canadian Rubber Company is about to erect a factory at Montreal, to cost $250,000.

Victoria, B. C., is in the market for large quantities of copper wire for city electric lighting.

Smiths Falls, Ont., will buy a pump and turbine waterwheel to be placed in the pumping station.

Montreal will spend nearly $300,000 for auxiliary pumping machinery for its waterworks system.

The Harvey Printing Company, Toronto, Ont., will erect a plant on Richmond, near Church street.

The Dominion Power and Transmission Company will spend $100,000 equipping new substations in Hamilton.

Arthur Surveyor, of Montreal, is interested in a million-dollar hydroelectric company, which will locate in Montreal.

J. B. Tudhope, of Orillia, is interested in the establishment of a $4,000,000 pulp and paper mill, at Spanish River, Ont.

The Alberta Electric Railway, with headquarters at Calgary, will make very important extensions requiring a great deal of machinery and new equipment.

The Lester W. David Company is equipping a mill at Ocean Falls, B. C., that will have a capacity of 500,000 board feet per day and will require 20,000 horsepower.

The Peterborough (Ont.) Radial Railway Company, operated by the Electric Power Company, will make important extensions and will be in the market for more equipment.

MINING

The Snowflake mine, Lynx Creek, Yavapai county, Ariz., is installing new equipment.

The Iron Blossom mine, Tintic district, Utah, contemplates the installation of a concentrating plant.

The Santa Gertrudis mine, in the Pachuca district, Mexico, is erecting a new 600-ton concentrating plant.

The Stedbar-Ax Company, operating in the Las Vegas district, Nev., will erect a 20-stamp mill at Eagle, Wash.

The Indian mine, near Forebay, Jupiter district, Cal., will install a stamp mill and additional equipment.

The Shea-Putnam Company, operating on Manhattan Dexter, Nye county, Nev., will install new electric equipment.

The Casa Diablo Gold Mining Company, near Laws, Inyo county, Cal., will increase the capacity of its stamp mill.

The West Mexican Mines, Ltd., operating the Rosario mine, at Guadalupe y Calvo, Mexico, will erect a 500-ton cyanide plant.

The Butte Creek Consolidated Mining Company, operating in the Oroville district, Cal., will build a new dredge on Butte creek.

The United States Treasury Mining Company, Chloride, New Mexico, will erect an ore-treatment plant of 50 tons daily capacity.

The Consolidated Pioche Mining Company, operating at Pioche, Nev., contemplate the erection of two concentrating plants in this section.

Luis Terrazas, Jr., Chihuahua, Mexico, contemplates installing an amalgamation and cyanide plant at his Virgen mine, near Coyame.

CATALOGS WANTED

Chas. A. Francis, superintendent, National Printing Machinery Company, Athol, Mass., would like to receive catalogs of machine tools.

FORTHCOMING MEETINGS

Society of Automobile Engineers, annual meeting, January 11 and 12, New York City; C. F. Clarkson, secretary, 1451 Broadway, New York City.

The National Civic Federation, eleventh annual meeting, January 12-14, New York City; D. L. Cease, secretary, 1 Madison avenue, New York City.

National Metal Trades Association, annual meeting, April 14, 1911, New York City, Hotel Astor. Robert Wust, commissioner, New England building, Cleveland, Ohio.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl Street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

MISCELLANEOUS WANTS

Caliper catalog free. E.G.Smith, Columbia, Pa.

Test indicators. H. A. Lowe, Cleveland, O.

B. Jahn, New Britain, Conn., makes dies, tools, specialties and stampings.

Wanted—Work for turret lathes and gear cutter. Box 222, AMERICAN MACHINIST.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Engineering work and drawings made, patents developed; reasonable prices. Box 300, AMERICAN MACHINIST.

Special machinery designed; drafting, tests, reports. Reliance Eng. Co., 113 Beekman street, New York City.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Send broken cast iron parts for repair by oxy-acetylene welding at one-fourth cost of new ones; pay after you test them. Waterbury Welding Works, Waterbury, Conn.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Modern fire arms factory with very extensive and complete machinery equipment and an A-1 organization would like to take on the manufacture of profitable line in connection with regular product. Box 301, AM. MACH.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, in the Hallenbeck Building, 497-505 Pearl St., Borough of Manhattan, New York City, N. Y., on Tuesday, January 31, 1911, at 12 o'clock noon. Dated, New York City, December 9, 1910. Robert McKean, secretary.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—First class machinist and toolmaker, one who can take charge of tool room, design new tools and improve old methods; must be alive and competent to produce results; give full particulars as to age, experience and wages expected. Address AMERICAN MACHINIST, X50, 150 Michigan Ave., Chicago.

Wanted—A designer; the advertiser, one of the largest automobile concerns in the country, not located in Michigan, has an opening for an experienced and practical designer who has made good in the past; the applicant must have a knowledge of foreign and domestic practice; state age, experience and salary expected; a good opportunity for a first class man. Box 282, AMER. MACH.

INDIANA

Wanted—Foreman to take charge of drop forge department, consisting of thirty hammers, twenty board drops and ten steam hammers; must be experienced in handling alloy steel forgings; none except experienced first class men need apply. Box 325, AM. MACH.

Wanted—Motor designer and factory engineer; good opening with large concern for experienced man; must be thoroughly competent and have previous experience designing and building successful motors; state age, previous positions, etc., in first letter; if satisfactory, will arrange personal interview. Address "Motor Designer," AMER. MACHINIST.

MASSACHUSETTS

Head draftsman and designer, experienced on rotary printing presses and folders. Box 132, AMERICAN MACHINIST.

Wanted at once, a practical gear man who can estimate on both gear and machine work; give full particulars. New England Gear Works, 100 Purchase St., Boston.

Wanted—An experienced operator of Acme and Cleveland automatic screw machines; must be able to tool up machines and design tools; location vicinity of Boston; a good position for the right party; no labor troubles. Box 321, AMERICAN MACHINIST.

MICHIGAN

Wanted—Experienced assemblers and mounters for machine tool work; steady work and good wages to the right men; ideal shop conditions. Grant & Wood Mfg. Co., Chelsea, Mich.

Foreman wanted with general machine shop experience on automatics and semi-automatics, lathes, milling machines and drill presses by large manufacturing concern in the Middle West; give age, details of experience and wages expected. Box 333, AMER. MACH.

MISSOURI

Wanted—Inspector on machine work in large manufacturing company in the West. Box 303, AMERICAN MACHINIST.

NEW JERSEY

Wanted—First class printing press designers, draftsmen and detailers; good position for men of ability. Hall Printing Press Company, Dunellen, N. J.

Wanted—Two experienced mechanical draftsmen and designers, for permanent position with large manufacturing concern in New Jersey; state age, education, experience and salary expected. Box 326, AMER. MACHINIST.

Wanted—A first class printing press mechanic, to fill position of inspector and foreman of assembling floor; must be a trained mechanic with experience in determining accuracy at work, and its requirements in fitting and operation; a man of judgment who will assume responsibility. Hall Printing Press Company, Dunellen, N. J.

NEW YORK

Gridley operators wanted; several good men on Gridley automatic machines. F.I.A.T., Poughkeepsie, N. Y.

Wanted—Experienced draftsmen for steam piping, structural steel and furnace work in small town, New York State. Box 308, AM. M.

Wanted—Machine shop foreman on iron valve work; good wages, plenty of work; must be experienced on this line. Box 311, AMERICAN MACHINIST.

Milling machine hands wanted; first-class men for Cincinnati plain and universal machines; steady employment, good wages. F.I.A.T., Poughkeepsie, N. Y.

A thoroughly competent foreman to take charge of an automobile repair business; must be a thoroughly good automobile adjuster. Youngs & Co., Newburgh, N. Y.

Wanted—Experienced man to take charge of sheet steel and machine work for gas ranges; must be a first class sheet steel man used to press work. "G. R. F.," AM. MACH.

Wanted—First class all-around machinists and toolmakers; state age, experience, married or single and wages expected; steady position for good men. Address P. O. Box 65, Elmira, N. Y.

Draftsman, quick and accurate worker, with experience in machine design. Address with particulars, Niagara Machine & Tool Works, Buffalo, N. Y., manufacturers of machinery for sheet metals.

Wanted—A salesman who can invest $50,000 in an old established concern of highest reputation who manufacture accurate machine tools; new, finely equipped plant. Box 324, AMERICAN MACHINIST.

Mechanical draftsman for technical paper illustrations; must be good rapid tracer and letterer; submit samples of work, state experience and salary wanted; permanent position in New York City. Box 305, AM. MACH.

Wanted—By large manufacturing company, an experienced salesman familiar with hydraulic and steam machinery; territory, South American countries; must speak Spanish; apply in writing, stating experience. Address "Hydrosteam," Post Office Box 824, New York.

Wanted—Two first class mechanical draftsmen, men with a thorough knowledge of and practical experience in designing light machinery of an intricate construction are the ones who will be given the positions, with salary commensurate with ability displayed. Box 331, AMERICAN MACHINIST.

OHIO

Wanted—Experienced man capable of taking full charge of assembling automobile engines; give age, experience and salary. Box 323, AMERICAN MACHINIST.

Wanted—First class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood and metal patternmakers, brass polishers, buffers, finishers, millwrights, hammermen and blacksmiths, who wish to increase their opportunities, to register with the free Employment Department of the National Metal Trades Association, New England Building, Cleveland, Ohio.

PENNSYLVANIA

Wanted—First class stoker and mechanical draftsman; in reply state experience, age, reference and salary expected. Box 322, AMERICAN MACHINIST.

Pump draftsman, first class, experienced man capable of designing simple and compound direct acting steam pumps for mine use; permanent position with good salary to the right man; don't apply unless you are thoroughly competent; give full particulars. Box 319, AMERICAN MACHINIST.

Assistant foreman wanted for a machine shop, for medium and heavy work; must be able to handle men and be familiar with modern machine tools to turn out work to the best advantage; permanent position for the right party; state age, experience and salary desired. Box 329, AMER. MACHINIST.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WEST VIRGINIA

Wanted—Man with considerable mechanical experience, mechanical engineer preferred, to superintend large stamping and manufacturing plant; must have fair education and executive ability; state experience and give present employment. "Stamping," AM. MACH.

WISCONSIN

Expert tool designer, having shop experience as well as technical training in pressed steel work to take charge of tool drafting room for large stamping plant in Milwaukee; unusual opportunity for an ambitious and capable man; state salary and past experience. Box 166, AMERICAN MACHINIST.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Superintendent or assistant, practical man of proven executive ability, experienced on accurate, interchangeable work, wishes to locate permanently and at once; best of references. Box 336, AMERICAN MACHINIST.

MASSACHUSETTS

Mechanical and civil engineer, with 17 years' shop, office and field experience, desires responsible position; heavy construction work preferred; high class man. Box 332, AM. M.

Wanted—Position as superintendent by man 49; was 10 years in last place, four in present; is a thorough mechanic of varied experience, well versed in all uptodate manufacturing methods and of producing duplicate parts; is a good executive. Box 327, AM. M.

MICHIGAN

Practical mechanic, who has been demonstrator, salesman and engineer for large machine tool company, also charge of equipment for one of the largest plants in the country, seeks salaried position in keeping with his experience with option of buying an interest later. Box 335, AMER. MACHINIST.

Position as general foreman or superintendent; 17 years' of practical and executive experience; an expert designer on all kinds of tools, dies and special machines; familiar with uptodate methods in all branches of manufacturing; first class organizer; employed at present; best of references. Box 330, AMERICAN MACHINIST.

NEW JERSEY

Designer or draftsman, technical university graduate (foreign), wide experience; young man of pronounced ability; specialist on jigs and fixtures, also designer of tools, shop appliances, auto machinery, labor saving devices, etc.; excellent references; investigate further. Box 317, AMERICAN MACHINIST.

NEW YORK

Gear expert desires change; seventeen years' practical experience and theoretical knowledge of gear cutting; executive ability; references. Box 320, AMERICAN MACHINIST.

Foreman, 34, now engaged; medium or heavy work; thoroughly conversant with piece work and uptodate methods; electrical or general machinery; references from present employer. Box 318, AMER. MACHINIST.

Commercial engineer, thirty-five years old, well connected at present, is looking for more responsible position as manager, or in charge of sales or production, where field will widen from personal effort. Box 338, AM. MACH.

Man of executive ability, 13 years' practical sales, purchasing and shop experience, foreign and domestic, now holding executive position, desires to hear from parties requiring man of this caliber; best references. Address Room 1006, 239 W. 39th St., New York.

Superintendent or general foreman of machine shop or manufacturing, thoroughly competent mechanic on steam engine, pumps and gasolene engine, with 20 years' practical experience, expert in jigs and fixtures, like to change position. Box 328, AMER. MACH.

OHIO

Works superintendent requires a position; thoroughly expert in modern methods of manufacture, machine tools, automobile and engineering specialties; machine tool concern preferred; age 36; American; best references. Box 312, AMERICAN MACHINIST

Position as works manager or superintendent; 14 years' experience in executive positions; a hustler having made good handling 2000 employees; ten years with present company; good reasons for changing; can earn $6000 year year; age 35 years. Box 334, AMERICAN MACHINIST.

PENNSYLVANIA

Draftsman, experienced on gas engines and producers up to 200 horsepower, desires position. Box 275, AMERICAN MACHINIST.

Tool designer and foreman wishes change; sober, steady practical mechanic; 18 years' experience; A-1 references; go anywhere. Box 337, AMERICAN MACHINIST.

Mechanical engineer of sixteen years' experience, uptodate in modern shop practice, good organizer and systematizer, skilled in cost reduction and increase of output, desires position as engineer or superintendent. Box 302, AMERICAN MACHINIST.

General manager, superintendent, production specialist; over 20 years' machine shop, foundry and office experience on interchangeable system of tool, machinery and mechanical specialty manufacturing; age 37; references. Box 316, AMERICAN MACHINIST.

WISCONSIN

Man of good education and wide practical experience, wants position as foreman of tool job, or on experimental work. Box 307, AMERICAN MACHINIST.

FOR SALE

For Sale—Two Waterbury Machine Company's bench power presses; one large drawing press, 3½ inch stroke; one Kearney & Trecker universal milling machine in first class condition; three Bosworth foot presses; one 2-spindle Gardam drill press; one 2-spindle Dwight-Slate drill press. Address P. O. Box 407, Waterbury, Conn.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

We have no drastic changes or plans in contemplation for 1911.

A weekly paper such as the AMERICAN MACHINIST cannot make definite plans very far in advance—it must follow the trend of events.

We will continue to make it the representative paper of the machine-making industry, the weekly record of its progress—only more so.

It is our aim to keep it the very best engineering paper published anywhere for any money.

* * * *

The AMERICAN MACHINIST is a free, independent forum where machine shop experience and economies can be discussed, sifted, analyzed and settled to the immediate and lasting good of all concerned.

It holds no brief for any concern nor any cult, but believes there is some good in almost every method and a place for almost every device.

* * * *

The name of the paper will be printed in color to differentiate it from the advertisement on the front cover.

The same general style of headings will be retained.

Our aim is to make it easy to find what you want and easy to read it when found.

We want you to see quickly what has been observed and recorded from week to week, read what you like and save what you want.

* * * *

We will continue to improve our selling section. The advertising will be made more and more newsy, informative and truthful—an interesting, reliable and up-to-week buying guide for the man responsible for results.

All of this represents the kind of paper you want and need. Be sure if it isn't your kind—it isn't ours.

We shall always welcome your criticism, your suggestions, and when we deserve it, your commendation.

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Only reliable products can be continuously advertised.